SCHOOL FACULTY PERCEPTIONS OF THE USE OF TECHNOLOGY TO ACCOMMODATE DIVERSE LEARNERS: A UNIVERSAL DESIGN FOR LEARNING FRAMEWORK

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

DOCTOR OF EDUCATION

BY

SCOTT M. WYNDHAM

DISSERTATION ADVISOR: MICHAEL W. HARVEY

BALL STATE UNIVERSITY

DEPARTMENT OF SPECIAL EDUCATION

MUNCIE, INDIANA

JULY 2010

SCHOOL FACULTY PERCEPTIONS OF THE USE OF TECHNOLOGY TO ACCOMMODATE DIVERSE LEARNERS: A UNIVERSAL DESIGN FOR LEARNING FRAMEWORK

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

DOCTOR OF EDUCATION

BY

Scott M. Wyndham

APPROVED BY:

______________________________	________________
Committee Chairperson	Date
______________________________	________________
Committee Member	Date
______________________________	________________
Committee Member	Date
______________________________	________________
Committee Member	Date

Ball State University

Muncie, Indiana

July 2010

Dedicated to Autumn, Abigail, and Adelyn:

my princesses who are the loves of my life and

whose support has allowed me to reach this goal.

Abstract

Public policy and current educational reforms have challenged schools to close the achievement gap for all students, including those with disabilities as required under the No Child Left Behind Act (NCLB) of 2001. As schools seek to implement sound instructional practices for students, technology has become a dominant force in schools and society. The focus of improving instruction and meeting the needs of diverse learners has not yet blended with the technology capabilities that are more readily available in schools. Universal Design for Learning (UDL) seeks to build an inherent flexibility into the curriculum and to utilize technology to accommodate diverse learners.

The purpose of this study was to analyze how UDL training impacted school personnel's perceptions of inclusion, instruction, student engagement, and the use of technology to differentiate instruction to meet the needs of diverse learners. The sample consisted of faculty from 50 Indiana schools, and analysis was completed based on respondents' level of UDL training. Significant differences were found in perceptions that the primary responsibility for accommodating classroom activities for students with disabilities lies with the special education teacher, as well as whether accommodations designed for students with disabilities create increased opportunities for all learners. Significant differences were also found in how technology is used to provide choice and flexibility to students and differentiate instruction. There were significant differences in faculty perceptions that choice and technology impacted students' levels of engagement. Significant differences were found among variables based on respondents' categorization as general education or special education, as well as categorization as administrators or teachers.

Acknowledgements

I would like to thank my committee chair, Dr. Michael Harvey, for his support and time in assisting me through this journey. I appreciate his guidance, expertise, and high expectations throughout my coursework and this study. I would also like to thank the other members of my committee, including Dr. Marilynn Quick, Dr. John Merbler, and Dr. Peggy Rice. At each step along the way, their support and eagerness about this project provided me needed encouragement.

This project would never have been completed without the support and encouragement of my Ball State cohorts, Adam Bauserman and Joni Schmalzried. I could never have imagined in our first class several years ago how much I would lean on them for advice and encouragement. Vicki Hershman, State Project Director of PATINS, was also critical to the success of this study. Her expertise and resources in UDL, as well as her willingness to provide guidance along the way were key to completing this study.

I would also like to thank my family for always caring and asking how this project was going. My parents, Eric and Marsha, have encouraged and supported me throughout my life and taught me early the benefits of setting goals and working hard to achieve them.

Finally, my wife, Autumn, has never wavered in her support of me. Throughout years of classes and seemingly endless hours of work, she has been my rock. I love you more than you know! My girls, Abigail and Adelyn, are truly daddy's little princesses and while they do not realize it yet, their hugs and kisses have kept me sane throughout this process!

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

CHAPTER ONE

Introduction

Today's public schools are operating with unprecedented focus and pressure to address the academic needs of all learners, including those from various races, socioeconomic levels, abilities, and backgrounds. Thirty years of public policy and educational reforms have greatly changed the commitment of public schools to teach high standards to all learners (Gordon, 2009). While diversity has become the norm in public school, the curriculum and instruction have typically been designed to address the needs of the middle or average student while neglecting others (Rose & Gravel, 2009).

As diversity has increased in schools, so has technology. Technology has become a foundational component of American society. A survey conducted by the Pew Internet and American Life Project found that 73% of adults in America use computers (Rainie, 2004). Over 78% of children age 12-17 use the computer for online activities (Levin & Arafeh, 2002). Computers and technology have become woven into the fabric of American society. The average college freshman has spent over 10,000 hours playing video games, 20,000 hours watching television, and thousands of additional hours e-mailing, using the Internet, text-messaging, and other technology-based activities (Prensky, 2001). Compared to the 5,000 hours that students have spent reading (Prensky, 2001), technology's impact on today's young adults becomes evident.

Children engage with digital media up to six hours per day (Education Technology Council, 2007). However, Indiana students spend an average of between one and five hours per week using technology at school (Education Technology Council, 2007). Young adults in today's society are growing up as *digital natives* who are most comfortable in the fast-paced digital realm of computers, video games, and the Internet (Prensky, 2001). Young digital natives are not just more comfortable with technology than their parents and teachers, but digital technology has become an integral part of their lives and is incorporated throughout their daily routines (U.S. Department of Commerce, 2005). Educators need new strategies and tools that allow their students to experience teaching and learning in ways that correspond to the changing nature of the world in which students live (Solomon & Schrum, 2007).

As technology has expanded throughout society and generations of students can best be characterized as digital natives, many teachers and administrators have begun to utilize technology in attempts to improve the achievement of students. Over the last two decades, the numbers of computers in American schools has increased from 250,000 in 1983 to 8.6 million in 1998 (Becker, 2000). In 1997, American schools spent $3 billion on technology (Coley, Cradler, & Engle, 1997). According to the 2006 State Technology Report, schools contain an average of one instructional computer for every 3.8 students (The Information Edge, 2006). While there is disparity among funding for technology between schools (Coley et al., 1997), the Consortium for School Networking (n.d.) summarized their research findings and asserted, “Where there’s a will to deepen schools’ commitment to technology, there seems to be a way—and this seems more important than funding” (p. 5). Even while schools have increased the digital technologies available, 83% of students age 12-17 report that they use online tools more at home than at school (U.S. Department of Commerce, 2005).

While technology is more prevalent in schools, its role in the curriculum and pedagogy of American schools is varied and emerging. While technology has increased in schools and has changed the way people interact with their world, education has not yet embraced it to the same extent (Barton & Orwig, 1993; Solomon & Schrum, 2007). As schools strive to better prepare students for the future, they must utilize new strategies and tools to engage and prepare them for the technological world (Solomon & Schrum, 2007).

Public Policy

For students with disabilities, a driving force in furthering technology application in education has been the federal government's prompting and support, without which many of the advances made in technology would not have been possible (Blackhurst, 2005). When the Education for All Handicapped Children Act became law in 1975, its goal was to provide students with disabilities physical access to schools. While the goal of access to public schools has largely been achieved, the focus shifted to progress in the curriculum with the reauthorization of the Individuals with Disabilities Education Act (IDEA) of 1997 (Nolet & McLaughlin, 2000). The shift from access to progress in the general education curriculum was cemented with the 2004 reauthorization of IDEA (§ 300.320(a)), which specified:

> each child's IEP [individualized education plan] must include annual goals to enable the child to be involved in and make progress in the general education curriculum, and a statement of the special education and related services and supplementary aids and services to enable the child to be involved and make progress in the general education curriculum. (p. 46552)

Technology is incorporated into IDEA 2004 (§ 300.5) primarily through assistive technology and the requirement that IEP teams determine whether assistive technology is needed to increase, maintain, or improve the functional capabilities of a child with a disability. IEP teams must consider whether a technology device is necessary in order for the child to receive a free appropriate public education (FAPE). IDEA 2004 furthered the use of technology to create more accessible instructional materials with the National Instructional Materials Accessibility Standard (NIMAS). The NIMAS standard required states and local education agencies to “provide access to print instructional materials, including textbooks, in accessible media, free of charge, to blind or other persons with print disabilities” (34 CFR 300.172(e)(1)(ii)). NIMAS required local and state education agencies to provide digital file sets to ensure access to curricular materials for students with these disabilities (National Instructional Materials Accessibility Standard, 2006). Rose, Meyer, and Hitchcock (2005) asserted, “NIMAS will help to ensure that the ubiquitous textbook will be within reach of many students with disabilities at the critical point of instruction in an accessible and usable form” (p. 7).

While 30 years of legislation has been passed promoting access to public education for students with disabilities, little has been done to impact an inflexible curriculum that significantly limits teachers’ abilities to address the needs of students in their classes (Meo, 2008). The original intent of IDEA to grant students with disabilities physical access to public schools left many students sitting in regular classrooms with little access to the general education curriculum (Nolet & McLaughlin, 2000). Simply being included in a general education classroom with no access to necessary supplementary aids and services is not sufficient to promote access to the general education curriculum for students with disabilities (Soukup, Wehmeyer, Bashinski, & Bovaird, 2007). Dolan and Hall (2001) discuss the "dreadful irony that students with disabilities have better access to school buildings than they do to the curricula within them" (p. 22). IDEA 1997, followed by the subsequent reauthorization in 2004, shifted the focus from *access* to *progress* in the general curriculum and created an environment in which teachers and administrators must become more adept at differentiating instruction and assessments to facilitate adequate progress. Educators are challenged to create the conditions for progress by maintaining high expectations for students with disabilities in the general education curriculum (Hehir, 2005) and by promoting flexibility in adjusting instruction to meet the needs of students (Nolet & McLaughlin, 2000).

Significant changes have occurred for students with disabilities and their expectations in the general curriculum from the initial passage of Education for All Handicapped Children Act in 1975 and the most recent reauthorization in IDEA 2004. Within those three decades, public education has received more focus and more public attention (Gordon, 2009). *A Nation at Risk: The Imperative for Educational Reform* was published in 1983 and threatened the impact that mediocrity in schools was having in America's place within the global community. Major focuses of *A Nation at Risk* included high academic standards, higher expectations, stronger content, more support for teachers, and more accountability (National Commission on Excellence in Education, 1983). The publication of *A Nation at Risk* led to a tremendous increase in state and local education reforms in the months and years following its release (Gordon, 2009).

In 1994, President Clinton's Goals 2000: Educate America Act placed additional focus on educational standards and accountability in the form of assessments in reading and mathematics. Following this initiative, the federal government began supporting more professional development for teachers and more technology supports in classrooms. Goals 2000 furthered the influence and control that the federal government had in public education (Gordon, 2009).

The reauthorization of IDEA in 1997 furthered the inclusion of students with disabilities in the standards-based reform movement through its emphasis on their inclusion in state accountability systems. IDEA 1997 required individual education plans (IEPs) to contain a statement of modifications needed in the administration of state or district assessments of student achievement. In circumstances where IEP teams determined a child would not participate in state or district assessments, IEPs must explain why assessments were not appropriate for that student (§300.347(a)(5)(i)). IEP teams could determine students would participate in an alternate assessment, and the performance of these students must also be reported along with their non-disabled peers (Nolet & McLaughlin, 2000). The inclusion of students with disabilities in state and local assessments initiated a stronger focus on the performance of students with disabilities while holding school districts accountable for their achievement (Hehir, 2005). The challenge of IDEA 1997 was that the requirement for students with disabilities to participate in state and local assessments was established before consideration had been given on how best to assess these students. Subsequent attention has been given to accommodations and modifications of assessments. However, further consideration of universally designed assessments may better anticipate the needs of students with disabilities (Hehir, 2009). Such consideration of UDL philosophies coupled with existing accountability measures would allow the focus on increased expectations for students with disabilities to be fully realized through assessments that are better equipped to assess student progress.

A significant milestone in the federal government's influence on education and in the history of students with disabilities' access to the general education curriculum was the No Child Left Behind Act of 2001 (NCLB). Prior to the mid-1990s, students with disabilities had largely been neglected in the standards-based reform movement (McGrew, Thurlow, & Spiegel, 1993; Nolet & McLaughlin, 2000). In its effort to leave no child behind, NCLB mandated that all public school students reach proficiency in reading-language arts and math by the 2013-2014 school year. The law specifically mandated that districts focus and report on progress of the following subgroups of students: economically disadvantaged, major racial and ethnic groups, students with disabilities, and students with limited English proficiency. NCLB further required teachers be highly qualified in the subjects they teach and based academic success on student performance on standardized tests (P.L. 107-110, NCLB).

Skrtic, Harris, and Shriner (2005) grant NCLB its proper significance when they assert, "The inclusion of students with disabilities in the outcomes-based accountability mechanism of NCLB is the most important advance in special education policy since enactment of the Education for All Handicapped Children Act of 1975" (p. 3). As schools seek to reach the 100% proficiency standard for even students with disabilities, the concepts of promoting access to the general education curriculum and differentiated instruction are critical to the professional development of teaching staff. Strangman and Dalton (2005) suggest, "Supported, adjustable digital learning environments can help ensure that every teacher reaches the goal of leaving no child behind" (p. 565).

With a growing research base in differentiated instruction and brain research, Universal Design for Learning (UDL) has emerged as a framework to serve as the "intersection of initiatives" (Rose & Meyer, 2002, p. 7) blending technology with other pedagogical practices, including learning styles, differentiated instruction, and cooperative learning. Coyne et al. (2006) indicate that "UDL synthesizes – or at the very least complements – a number of educational approaches" (p. 2). As mandates have increased for schools to demonstrate proficiency and progress for all students, the focus on examining instruction and access to learning has become more intense.

Universal Design for Learning stems from the universal design movement in architecture which arose following the passage of the Americans with Disabilities Act (ADA) of 1990. In order to meet ADA mandates, public buildings needed to be made accessible to individuals with disabilities with the addition of ramps, elevators, and wider doorways (Pisha & Coyne, 2001). Mace, Hardie, and Place (1996) coined the term "universal design" in architecture to describe consideration of the needs of the broadest range of users from the beginning of building design. Architects found it to be more cost effective and aesthetically pleasing to conceive, design, and construct buildings to accommodate the widest range of users. Rather than build subsequent adaptations to buildings to accommodate individuals with special needs after construction, proponents of universal design in architecture incorporated accessibility into the plans from the beginning stages (Rose & Meyer, 2002). The Center for Universal Design at North Carolina State University identified the following seven key principles of universal design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (Sopko, 2008). The universal design movement in architecture "provides a blueprint for maximum inclusion of all people" (Mueller & Mace, 1998, p. 6). Applying this same blueprint and focus on accommodating the widest range of users within the field of education is the premise of UDL.

With a growing focus on instruction and curriculum, universal design or UDL has been referenced in several regulations and government reports over the last ten years, including the Higher Education Opportunity Act of 2008, the Assistive Technology Act of 2004, the President's Commission on Excellence in Special Education in 2002, and the reauthorization of IDEA in 2004. The Higher Education Opportunity Act of 2008 (HEOA) referenced UDL as a scientifically valid framework that

> (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and
>
> (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including those with disabilities and students who are limited English proficient [HEOA, P.L. 110-315, §103(a)(24)].

The Assistive Technology Act of 2004 referenced universal design and defined it in Section 3(a)(19) as:

> a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly accessible (without requiring

assistive technologies) and products and services that are made usable with assistive technologies.

This definition was referenced in the reauthorization of IDEA in 2004 (§300.44).

The Report of the President's Commission on Excellence in Special Education (U.S. Department of Education, 2002) specifically promoted that “all measures used to assess accountability and educational progress be developed according to principles of universal design" (p. 27). The Commission Report acknowledged that students with disabilities are often excluded from statewide assessments because they are designed “without consideration of modifications or accommodations students with disabilities may need to complete the assessment” (p. 27). The report suggested the creation of assessments with accommodations and modifications that enhance accessibility but do not invalidate results. IDEA 2004 specifically referenced universal design in 300.704(b)(4)(v) to promote districts supporting "the use of technology, including technology with universal design principles and assistive technology devices, to maximize accessibility to the general education curriculum for children with disabilities" (p. 269).

The starting point for ensuring access to the general education curriculum is the development of standards and accessible curriculum design linked to those standards (Wehmeyer, 2006). Finding ways to accommodate the curriculum is essential as too many students with disabilities are receiving a modified curriculum that could ultimately hamper their progress, expectations, and post-secondary goals (Hehir, 2005). Gregg (2007) asserted, “Mere exposure to the curriculum will not ensure proficiency, and it will certainly not help bridge the gap in the learning of students with special needs” (p. 165).

Gregg (2007) compared the academic gap for some students with disabilities to the Grand Canyon and asserted that the only way to bridge a gap that wide is to present teachers with specific strategies for instruction and assessment.

UDL is a broad framework intended to impact the entire curriculum, including goals, materials, methods, and assessment (Meo, 2008). King-Spears (2009) asserted, "UDL is not defined by or confined to technology. The technology must be combined with effective pedagogy, which can either stand alone as UDL or stand with the technology" (p. 201). While UDL is a broader framework than the integration of technology into the curriculum, the technological innovations and digital media available provide ideal opportunities for teachers to build flexibility into their lessons and accommodate the diverse needs of students within their classrooms (Strangman & Dalton, 2005; Meyer & Rose, 2005; Gordon, 2009; Edyburn, 2010). Materials that are available in digital formats provide a flexibility and accessibility that enhance UDL implementation (Hall, Strangman, & Meyer, 2003). While UDL is about more than technology, Edyburn (2010) contended that technology is necessary to advance UDL within schools or it will become an educational fad forgotten in a few years. Specific technologies such as Smart Boards, text-to-speech programs, mobile technology devices, software programs, and web-based tools provide teachers with tools to create more flexible lessons and increase accessibility of the curriculum for all students, including those with diverse learning needs.

While flexible and adaptable lessons are a key component of UDL, assessments are also an area where accessibility is critical to monitoring student progress. High-stakes testing has become a fundamental component of the standards-based reform movement;

however, there is a disconnect between how high-stakes assessments are conducted and what educators know are the best ways to assess student learning (Hehir, 2009). Once assessments are universally designed to accurately measure student performance, teachers would be able to support effective learning by utilizing assessments that drive instruction (Hehir, 2009). Shifting the burden of change from students, who may or may not be able to access the curriculum, to the curriculum itself is a powerful shift in practice (Meo, 2008). UDL is not about lowering standards or teaching to the middle or average of the class, but providing flexibility and alternatives to allow the general education curriculum to be accessible to every student (Orkwis & McLane, 1998). In seeking to equip teachers to instruct in more flexible and adaptable ways, UDL offers schools a framework to adapt instruction to better address the unique needs of all students.

As technology innovations have become more prevalent in schools, there has been increased focus on how the principles of universal design can also be applied to education and learning. For decades, teachers have retrofitted instruction and assessments after their creation in an attempt to accommodate for diverse learning needs (Hitchcock, Meyer, Rose, & Jackson, 2005). Lessons and assessments were created that were not accessible or appropriate for many students with unique learning needs. Special educators have been charged with making accommodations to allow students with disabilities to participate in these aspects of the general education curriculum. However, proponents of UDL would assert that collaborative approaches combining general education and special education techniques are better able to address the needs of students with disabilities (Jackson, Harper, & Jackson, 2005). While teachers agree that adaptations are needed to effectively teach their lessons, they also report there is insufficient time to plan and make the needed adaptations (Orkwis & McLane, 1998). The benefits of a digital curriculum rooted in UDL include less onerous adaptations and media that are flexible and can be manipulated with greater efficiency and effectiveness (Jackson & Harper, 2005). UDL implementation involves fostering collaboration between general education and special education personnel to create an environment that is conducive to cooperative planning, adaptation of lessons and assessments, and integration of technology supports. In a UDL framework fostering this type of environment, the amount of time spent adapting lessons and activities, accommodating or modifying the curriculum, and retrofitting assessments should decrease.

Purpose of the Study

If it is more cost-effective and beneficial for architects to plan, design, and construct buildings with diversity in mind, how might instruction be impacted if educators implemented similar practices by building inherent flexibility into their daily instruction and assessments? The purpose of the proposed study is to analyze how training in UDL impacted school personnel's perceptions of inclusion, instruction, student engagement/performance in the classroom, and using technology to differentiate instruction to meet the needs of diverse learners. While there is an increasing emphasis on students with disabilities receiving core instruction in general education classrooms, there are limited strategies that lead educators to create environments in which the curriculum and instruction are made accessible (Lee et al., 2006). Students with disabilities comprise an important subgroup that may challenge teachers in their differentiation of instruction. The adoption of a UDL framework promotes viewing students' strengths and weaknesses along a continuum rather than lumping students into categories (Meyer & Rose, 2000). The UDL framework supports accommodations for students with disabilities that are located within instruction to support the range of students within classrooms (Grabinger, Aplin, & Ponnappa-Brenner, 2008).

While generations of students are now being characterized as digital natives, their teachers can often best be characterized as digital immigrants (Prensky, 2001). This distinction suggests they were not born into the digital age as were many of their students. However, digital immigrants have, at some point, gained interest and adopted many aspects of the technological world. Prensky (2001) suggested that this distinction between digital natives and digital immigrants is more than just semantics, but is the "single biggest problem facing education today" (p. 2). Teachers (digital immigrants) continue to teach in a standard and traditional manner, while today's students (digital natives) speak and respond to an entirely different approach. The Indiana Plan for Digital-Age Learning (Education Technology Council, 2007) suggested that technology use in education is important to more fully engage students in learning, increase their academic achievement, and allow them to be more competitive in the technological world in which they will eventually live and work. Analyzing this approach and distinguishing what factors have helped schools connect teachers, students, and curriculum using UDL is the goal of this research.

Limited empirical research has been conducted in the area of Universal Design for Learning as it applies to classroom instruction and changes in instructional practices. The research base is growing with regards to universal design applied to test delivery and large-scale assessments (Dolan, Hall, Banerjee, Chun, & Strangman, 2005; Johnstone, 2003; Dolan & Hall, 2001; Thompson, Johnstone, & Thurlow, 2002). While this is an important area because of the heightened emphasis on high-stakes testing and accountability, the impact of UDL on classroom instruction and the factors that contribute to its adoption within a school would yield similarly valuable information. At this point, there is not scientifically validated research on UDL as an instructional practice and intervention (Edyburn, 2010). In addition to impacting how students are assessed, UDL implementation should influence how teachers design and implement their lessons, and how they view their ability to accommodate for diverse learners within the general education curriculum.

Curriculum design and implementation built on the principles of universal design should have positive outcomes for students with and without disabilities (Wehmeyer, Lattin, & Agran, 2001). A close examination of schools and teachers who have implemented a UDL framework elicits valuable information as administrators and researchers seek to ensure that the technology commitments made by schools are yielding maximum results. This examination of schools that have incorporated UDL principles into their instruction will demonstrate how faculty perceptions of student engagement and achievement, as well as inclusion and classroom instruction, were influenced. Through an analysis of factors that contributed to technology integration, additional information will be obtained. These analyses are significant as UDL becomes more widely recognized and implemented across the country.

Universal Design for Learning is gaining in awareness and support at the federal level (Samuels, 2009; Muller & Tschantz, 2003), and a requirement that states develop a plan for implementation of UDL was included in the draft bill reauthorizing the No Child Left Behind Act released by the House Education and Labor Committee in August 2007

(Samuels, 2009). In addition, UDL was supported in a Senate reauthorization sponsored by Senator Joseph Lieberman (Samuels, 2009). The National Center for Learning Disabilities suggested,

> If embraced by the field of education, [UDL] can dramatically change the school experiences and success of students with LD [learning disabilities] by making broad changes to how information is presented to all students and the ways in which all students are able to show what they know. (Cortiella, 2008, p. 1)

Across the country, states are embarking on initiatives to develop and implement a UDL framework. Indiana, the setting for this study, has had a UDL state-wide initiative in place since 2003 (Samuels, 2009). Kentucky, New York, California, Michigan, and Ohio are also at different levels of implementation in state-wide UDL initiatives (Samuels, 2009; Muller & Tschantz, 2003).

In the fall of 2007, a group of leaders in the field of UDL convened in Washington, DC to discuss UDL and identify needs and opportunities for implementation. Several challenges were addressed in the UDL National Summit including the need to create exemplars and models of UDL in practice. The summit recommended strengthening the links between existing research and developing model sites or pilot sites to demonstrate UDL. The summit also prioritized a need to "raise the quality and number of education research projects that investigate UDL approaches to build on a growing empirical basis for UDL" (CAST, 2007, p. 5). This focus was expanded to include studies that develop and research UDL's features and functioning, as well to what extent UDL benefits all learners. The proposed study of the impact of UDL training on faculty perceptions addresses many of the recommendations made by the National UDL Summit.

Research Questions

This study addressed the following questions concerning Universal Design for Learning and its implementation in schools:

Research Question 1

Are there differences in faculty perceptions of the inclusion of students with disabilities in general education classrooms between those who participated in UDL professional development and those who have not?

Research Question 2

Are there differences in how technology is used in the classrooms of teachers who participated in professional development in UDL and those who have not?

Research Question 3

Are there differences in faculty perceptions of students' level of engagement in classroom activities between those who participated in UDL professional development and those who have not?

Research Question 4

What factors are identified by school faculty that positively impact the use of technology to accommodate the needs of diverse learners?

Definitions

In this review of relevant literature and research, the following terms will be discussed:

Universal Design for Learning (UDL)

UDL is a framework based on the universal design movement in architecture that promotes the design of instructional materials and activities with an inherent flexibility that meets the needs of diverse learners by improving access to information and learning (Rose & Meyer, 2002) with little or no need for further accommodations (Sopko, 2008).

Assistive Technology Device

Assistive technology device is defined as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability" (IDEA, 2004).

Digital Natives

Digital natives are defined as students who have grown up in the digital age and are "native speakers of the digital language of computers, video games, and the Internet" (Prensky, 2001, p. 1).

Digital Immigrants

Digital immigrants are defined as individuals who were "not born into the digital world, but have, at some later point…become fascinated by and adopted many or most aspects of the new technology" (Prensky, 2001, p. 2).

Significance of Study

Universal Design for Learning is a relatively new framework that has emerged over the last decade (Rose & Meyer, 2002). As schools seek to align their technology resources in such a manner that allows for more flexibility and differentiation within the curriculum, research is warranted that examines school faculty who have incorporated

UDL into their instruction. While the universal design movement in architecture has led to increased accessibility for individuals with disabilities to buildings, many students are denied access to learning as soon as they open their textbooks (Pisha & Coyne, 2001). Given the large amounts of money expended by schools on technology and the growing demands for all students to meet proficiency standards, researchers should closely examine the impact that a UDL framework can have on classroom instruction. Research is needed that examines whether technology expenditures and tools implemented through a UDL framework lead to more positive outcomes in classroom application through stronger accommodations of diverse learners and increased accessibility of the curriculum.

Hitchcock and Stahl (2003) stated, “There is a major impediment to achieving high standards and accountability for special education students within the general education curriculum—the general curriculum is simply not designed for those students” (p. 3). Madeline Will, former Assistant Secretary for the Office of Special Education and Rehabilitative Services, criticized education in asserting,

> The state of the art in education is far ahead of the state of actual practice in the schools, even though improvements that have great potential benefit for both regular education and students with special learning needs seem feasible for implementation. (1986, p. 414)

The movement to include students with disabilities in general education classrooms began in the late 1960s when Dunn (1968) contended that special education was segregationist. This movement garnered increased attention when advocates (Gartner & Lipsky, 1987; Reynolds, Wang, & Wahlberg, 1987) strongly emphasized the elimination of special education and promoted the full inclusion of students with moderate and mental disabilities into regular education. However, others (Singer, 2005) have questioned whether regular education could assume entire responsibility for educating children with disabilities and asserted,

> Nothing has happened within regular education to solve this problem. Regular education is already so overburdened that it can hardly handle its own problems; it is not in a position even to conceive of handling problems that it has traditionally delegated to special education. (p. 15)

Kauffman and Hallahan (2005) raised similar concerns about full inclusion and emphasized why special education was necessary within the field of education. Kauffman and Hallahan stated, “Special education originated because the education designed for most children was not having the desired effect on some. Educators saw that the appropriate education of all children required different instruction (i.e., special education) for a minority” (p. 150). The authors asserted that the full inclusion movement had reduced the alternatives and service delivery options available to meet the needs of students with disabilities. While not promoting full inclusion, the premise of UDL and differentiated instruction is that lessons, activities, and assessments can be created in ways that more appropriately address the needs of students with differing skills and abilities within the general education curriculum. A significant step in addressing Singer’s (2005) concern that nothing had happened within regular education to address the needs of students with disabilities would be adoption of UDL principles across the field of general education.

While a movement towards full inclusion has not been supported in subsequent reauthorizations of IDEA, the 2004 reauthorization highlighted a relationship between access to the general education curriculum and placement in a regular classroom while indicating a strong preference for education in the least restrictive environment (Karger, 2005). The best chance that students have to access the general education curriculum is in the general education class. Education in separate special education classrooms tends to be geared towards IEP goals and objectives and not the general education curriculum (Soukup et al., 2007).

The American Association of School Librarians *Standards for the 21st Century Learner* (2007) contains common belief statements that adequately frame the importance of a UDL framework. First, technology skills are crucial for future employment needs. Second, equitable access to information, books, and texts is a key component for education. Schools included in this study have begun incorporating UDL into their teaching practices in an attempt to design instruction and assessments that are more flexible in addressing student needs. As UDL grows in prominence, other schools will be seeking research such as this to help guide their utilization of technology to meet the needs of all students. In discussing the joint forces of policy mandates and technology innovation, Silver-Pacuilla (2006) emphasized, “Not seizing this opportunity to share the potential of assistive and learning technology as a powerful part of an achievement solution would consign the field to the margins of the education reform effort” (p. 9).

Teachers face a challenging task in meeting the mandates of NCLB, while facing classrooms with more students representing a wider spectrum of diversity in learning styles and abilities (Meyer & Rose, 2000). As schools strive to incorporate adequate technology into their buildings and programs, they are spending more money than ever before on technology. In fiscal year 1998, schools spent about 2.7% of total educational expenditures on technology. This amounted to approximately $7.2 billion. The average school spent $113 per year per student on technology, with $22 supporting teacher support services, $8 supporting software, and the remaining $83 supporting hardware (Anderson & Becker, 2001). The average number of computers per school has increased from 75 in 1995 to 154 in 2005, while the percentage of children who use computers for schoolwork has increased from 61% in 1993 to 90% in 2003 (D'Orio, 2008). Schools and classrooms have more technological tools and capabilities than most educators would have imagined just ten years ago. As superintendents and local school boards seek to justify their increased expenditures and technological capabilities in schools, there is a need for empirical evidence of the impact on classroom instruction. While more technological resources are available, schools often fail to provide students with opportunities to use technological tools, as well as their own technological skills and interests, for the purpose of learning (Solomon & Schrum, 2007; Siemens, 2004). Technological innovations and digital media have created new opportunities for teachers to plan for diversity within their inclusive classrooms (Orkwis & McLane, 1998).

Technology use in education has evolved from the pre-computer technology era which began in 1808 with the precursor to Braille to the present-day where a great array of technological innovations are available (Blackhurst, 2005). Since the 1997 reauthorization of IDEA, students with disabilities have been entitled to access assistive technology devices in order to receive a free and appropriate public education (§300.308). When thinking about technology for students with disabilities, most educators think of assistive technology (Rose, Hasselbring, Stahl, & Zabala, 2005). Rose and colleagues (2005) suggested that the primary focus of assistive technology is to "assist individuals with disabilities in overcoming barriers in their environment and in increasing their opportunities for independence" (p. 509). Assistive technology is utilized after curricular materials have been produced (Wehmeyer, Lance, & Bashinski, 2002), while the premise of UDL is that barriers should be reduced for all learners from the creation of curriculum and instruction (Rose & Meyer, 2002). Classrooms are then inherently flexible in a manner that uses technological tools to accommodate all students (Rose & Meyer, 2002). The Assistive Technology Act of 1988 specified that utilizing universal design principles reduces the need for assistive technology devices and services because accommodations are built in before production, rather than after (Sec. 2(a)(10)).

Assistive technology and UDL are not competing forces, but are compatible and complementary to one another (Hitchcock & Stahl, 2003; Silver-Pacuilla, 2006; Cortiella, 2008). However, the focus and manner in which the two address barriers to learning is conceptually very different. While UDL and assistive technology complement each other, UDL integration into the curriculum will still leave some students requiring specific assistive technology to address unique learning needs (Silver-Pacuilla, 2006). However, as UDL principles become more integrated into schools and programs, fewer students with disabilities should need the individualized supports that were once only available through assistive technology (Cortiella, 2008). The PATINS Project, the state-sponsored program that administered the UDL program which is the focus of this study, has been providing services to Indiana schools to assist in addressing assistive technology needs for 15 years. The UDL grant program was implemented six years ago to complement their work in assistive technology.

IDEA 97 required schools to develop an IEP and special education program for a child with a disability that conferred measurable and meaningful education progress in the general education curriculum (Sec.614(d)). Further, the general education setting was the presumed starting point for each student's individualized program and services (Sec.612(a)(5)). IEP teams must explain why a student was being removed from that setting (Yell, Drasgow, Bradley, & Justesen, 2004) and balance the high expectations of the general education curriculum with the unique needs of the student with a disability (Wehmeyer et al., 2001). IDEA 97 raised educators' expectations and challenged schools to ensure students with disabilities experienced an education that was appropriately challenging (Wehmeyer et al., 2001). In reviewing the impact of IDEA 97, Eyer (1998) emphasized the following:

> The IDEA can no longer be fairly perceived as a statute which merely affords children access to education. Today, the IDEA is designed to improve the effectiveness of special education and increase the benefits afforded to children with disabilities to the extent such benefits are necessary to achieve measurable progress. (p. 16)

The 2004 reauthorization of IDEA blurred the lines of special education and general education by allowing states to implement a model for determining eligibility for a learning disability based on examining how a student responds to scientific, research-based interventions (§300.307). Response to Intervention (RTI) analyzes how a student responds to interventions to determine whether they remain in traditional core instruction or are moved to a different tier of intervention. A student's failure to respond to research-based interventions may lead to a diagnosis of a learning disability (Fuchs & Fuchs, 2006). While RTI focuses on students at-risk and their response to interventions, UDL focuses on increasing the accessibility and flexibility with which the curriculum is designed (Strangman, Hitchcock, Hall, Meo, & Coyne, 2009). There are similarities between RTI and UDL, including an acknowledgement that poor achievement in students may be a result of poor instruction. Both RTI and UDL recognize that the same curriculum may not be effective for all students and some may need additional interventions, flexibility, or differentiation to be successful. RTI and UDL also promote a view of assessment that is closely tied to classroom instruction with frequent and ongoing measures of student progress (Strangman et al., 2009).

By placing the onus for adequate instruction squarely on general education, IDEA 2004 responded to the criticism of the relationship between general education and special education first lodged by Dunn (1968), when he decried, "We have been living at the mercy of general educators who have referred their problem children to us" (p. 5). The IDEA 2004 mandate that general education provide research-based interventions prior to consideration for special education and that students with disabilities make progress in the general curriculum have built a focus on providing solid instructional practices within the general education environment.

IDEA 2004 further raised expectations for students participating in special education services and their programming and performance. IDEA 2004 affirmed the personnel standards of No Child Left Behind in asserting that special education teachers hold appropriate special education licensure as well as demonstrate subject-matter competency in each core academic subject in which the teacher teaches (§300.18(c)). IDEA 2004 also required that individual education plans (IEPs) for students with disabilities include a statement that special education and related services and supplementary aids and services are based on peer-reviewed research to the extent practicable (§300.320(a)(4)).

IDEA 2004 mandated that students with disabilities be educated with nondisabled peers and that removal from the general education classroom to a separate classroom/setting only be considered if the nature or severity of the disability is such that education in regular classes using supplementary aids and services cannot be achieved satisfactorily (§300.114(a)(2)). The 28th Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act (U.S. Department of Education, 2009) reported that in 2004, special education and related services under IDEA, Part B were provided to 6,118,437 students ages 6 through 21 (p. 39). This represents 9.2% of the general population of students ages 6 through 21 (p. 41). The report further documented that in 2004, 52.1% of students with disabilities ages 6 through 21 spent more than 79% of their school day in general education classrooms. Another 26.3% of students were in a general education classroom between 40 and 79% of their school day. Only 21.5% of students received their services outside the regular class for more than 60% of their school day or in separate environments (p. 51). The percentage of students receiving their education in regular classrooms for most of their day has increased 6.8 percentage points from 1995-2004 (p. 52). As a growing number of students with disabilities are being served in general education classrooms, teachers and administrators need strategies that allow them to address an increasingly diverse student population.

UDL is an "intersection of initiatives" (Rose & Meyer, 2002, p. 7) and is based on principles and practices that are grounded in research-based educational approaches for diverse learners (Meo, 2008; Meyer & Rose, 2005). Differentiated instruction, brain research, cooperative learning, and technology are all theories and strategies through which educators have pursued the notion of modifying and adapting instruction to meet the needs of students. The Center for Applied Special Technology (CAST) (2008) suggested that “UDL is based upon the most widely replicated finding in educational research: students are highly variable in their response to instruction” (p. 8).

Basic Assumptions

An assumption of this research is that various stakeholders within schools could contribute to an analysis of factors and perceptions relating to using a UDL framework to differentiate instruction and meet the needs of diverse learners. Another assumption is that participants in this research are comfortable with key education concepts, such as differentiated instruction, inclusion, various forms of technology (e.g., Smart Boards, Palm Pilots, Classroom Response Systems, blogs), and other concepts pertaining to the general education curriculum and special education (e.g., accommodations). This study was conducted using electronic surveys which required respondents to provide demographic information. It was assumed that the responses received from respondents were an accurate depiction of their perceptions. This study also assumed that the information obtained via the electronic survey would be unique to the individual respondent and that the respondent voluntarily provided the information. A final assumption was that the information provided on each survey was directly produced by the solicited respondent.

Summary

In 1975, when Congress passed Public Law 94-142, the Education of all Handicapped Children Act, it mandated that schools ensure access to public education and that students with disabilities be afforded a free and appropriate public education. The 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA) required that the IEP for every student in special education consider the need for assistive technology. These amendments also gave a student's IEP team the ability to select accommodations and/or modifications that the child needed in order to participate in state and local assessments (Bodine & Melonis, 2005). No Child Left Behind (2001) furthered that mandate by holding schools accountable for the progress of all students, including those with disabilities. As these legislative mandates have evolved, the focus for students with disabilities has shifted from access to public schools to progress in the general education curriculum (Hitchcock et al., 2005; Nolet & McLaughlin, 2000).

As schools strive to ensure progress for all students, the instruction, curriculum, and assessments that are utilized need to be closely examined. Students with disabilities need instruction that meets their individual needs, but does so without the stigma that has long been associated with special education (Will, 1986). Kauffman, Bantz, and McCullough (2002) promoted the restructuring of special education as a service and not a place, and as a part of flexible and responsive services that do not single out children. Kauffman and colleagues asserted, “What we see now as difference or special must become routine, accepted as part of the normal such that the stigmatization and separation of children is avoided" (p. 150). By building flexibility into general education classrooms and curriculum, teachers are able to design instruction with consideration of individual differences that students present.

When students require the supports of special education, the general education classroom should be the presumed placement with removal from general education only occurring if learning goals cannot be achieved in that setting. Removal from general education classrooms should not occur simply because general education cannot or will not accommodate the needs of students with disabilities (Hehir, 2005). As technology has become more integrated into American society, its role in education has transformed over time. Computers, digital media, and other technological advances provide teachers with new opportunities to meet the needs of diverse learners within the general education curriculum (Rose & Meyer, 2002). UDL provides teachers with flexibility and a framework to address the diverse needs of students through multiple means of representation, assessment, and engagement. UDL helps educators rethink their basic assumptions about curriculum, instruction, and assessment in order to gain a more accurate assessment of what all students know and ensure that the materials used in schools are not barriers themselves (Thompson et al., 2002).

By reviewing relevant literature, this study will trace how UDL fits into the current scope of improvement efforts in schools in Indiana. The reader will gain an understanding and historical perspective of how education has transformed since 1975 when students with the most significant disabilities were first given the ability to access public education to present day, when technological tools and digital media allow teachers great flexibility to meet the needs of all students. An observer walking into many schools across the nation might be amazed by the wide array of technological tools available for student use. Too often these tools are not utilized to their maximum potential or with the intent of accommodating diverse learning needs. When teachers are planning and designing instruction to be flexible from the outset, they can use technology to meet the needs of more learners, including those with significant and mild disabilities, students new to the English language, or those digital natives who learn best via digital means. The proposed study will analyze how educators can use those tools to not only accommodate student diversity, but to design, plan, and conduct classroom instruction and assessment to meet the needs of all students and prepare them to be citizens in the technological society of the 21st century.

CHAPTER TWO

Review of the Literature

Legislative Trends

When the United States Congress reauthorized the Individuals with Disabilities Education Act (IDEA) in 1997 (P.L. 105-17), the focus and intent shifted from furthering access to public schools to expecting progress in the general education curriculum for students with disabilities (Nolet & McLaughlin, 2000). The 1997 reauthorization required that students with disabilities be included in statewide assessments and connected improving the effectiveness of special education with improved educational achievement for students with disabilities (§300.346). No Child Left Behind (2001) further raised expectations by requiring schools to achieve adequate yearly progress by focusing on improved achievement of under-achieving students. NCLB furthered an expectation that if schools were held accountable for the educational achievement of students with disabilities, educational services for these students would improve (Karger, 2005). However, common teaching practices are not effective for many of these students who are now a major focus of school improvement efforts (Edyburn, 2006).

Classrooms contain growing diversity that goes beyond students with disabilities (Wahl & Duffield, 2005). The U.S. Department of Education's National Center for Education Statistics (2006) reported that in the 2003-2004 school year, English language learner (ELL) services were provided to 3.8 million students. This accounted for 11% of all students. The population of racial/ethnic minority populations in schools has grown from 34% of students in 1993 to 41% in 2003 (KewalRamani, Gilbertson, Fox, & Provasnik, 2007). Regardless of the level of diversity within a school, educators seek to meet the mandate of NCLB (2001) that all students reach academic proficiency by 2013-2014.

Theoretical Frameworks

Both the No Child Left Behind Act (NCLB) and the Individuals with Disabilities Education Act (IDEA) emphasized research-based practices as fundamental components of curriculum. Meeting the needs of diverse learners is not unique to a UDL framework. Rose and Meyer (2002) described Universal Design for Learning (UDL) as an "intersection of initiatives" (p.7). The UDL framework is based on principles and practices that are grounded in research-based educational approaches for diverse learners (Meo, 2008; Meyer & Rose, 2005). Differentiated instruction, brain research, cooperative learning, and technology are all avenues through which educators have pursued the notion of modifying and adapting instruction to meet the needs of students. Each of these theories and strategies will be discussed through an analysis of relevant literature. There are limited empirical studies examining UDL specifically. However, the Center for Applied Special Technology (CAST) (2008) suggested that “UDL is based upon the most widely replicated finding in educational research: students are highly variable in their response to instruction” (p. 8). This study will build upon that research and analyze the theoretical frameworks that lay the foundation for UDL, as well as recent empirical research specifically on UDL.

Brain Research

Brain research within neurological and cognitive sciences is combining with current education initiatives to offer increased possibilities for improving teaching and learning among students with diverse needs (Hardiman, 2001). Brain research is shedding light on the extent of differences that exist within each learner. Every student has a capacity to learn and by identifying the differences within each learner, teachers can create lessons that acknowledge these differences in order to improve instruction (Green, 1999). Brain research with its implications on classroom practice is rooted in cognitive psychology, education, and neurophysiological research (Green, 1999). By examining brain activity during various tasks, researchers can better equip teachers to create lessons that stimulate the specific centers of greatest mental activity within each student (Mason, Orkwis, & Scott, 2005). Understanding the recognition, strategic, and affective networks of the brain allows teachers to better understand the flexibility that is needed as they instruct an increasingly diverse class of students (Meyer & Rose, 2000). Creating a more flexible curriculum with instructional materials that are more accessible and adaptable allows teachers to provide learning opportunities that are rooted in current understanding of brain research.

In order to identify the educational implications of brain research, it is important to identify commonly held misconceptions about the brain. One misconception that has existed in education is that activities should be created that appeal separately to the left and right hemispheres of the brain and that educators needed to stimulate more right-brain thinking (Jensen, 1998; Wolfe, 2001). Current research demonstrates that the hemispheres of the brain function more as a whole (Gregory, 2005). When certain tasks are completed by an individual, various regions of the brain process different pieces of information. This distributed processing allows for complex functions, such as reading comprehension or language, to be performed in a short amount of time (Rose & Dalton, 2006).

Another misconception is that the brain grows in spurts as a whole, and that education should be designed around those growth periods. Research supports that the different areas of the brain develop variably and experiences cause the brain to change physiologically. As new dendrites are formed, cells increase in weight, and dendrites form additional branches (Rushton & Larkin, 2001). The brain changes over time due to anatomical and chemical factors. However, brain research has also found physical changes in the structure of the brain when it learns (Rose & Dalton, 2006). A final misconception is that humans only use a small percent of their brains. Bransford, Brown, and Cocking (1999) countered this suggestion with research finding "silent areas" (p. 102) that are crucial to human learning in mediating higher cognitive functions, but that are not directly utilized for activities.

The brain contains three primary networks that are essential to learning. The recognition network assigns meaning and allows students to identify and understand information. The back half of the brain houses the recognition network and is particularly useful during pattern recognition that is utilized in reading (Meyer & Rose, 1998). The recognition network of the brain is critical in quickly recognizing complex processes (e.g., reading). The brain performs these tasks quickly by distributing the task of recognition across multiple, interconnected, and specialized areas of the brain working simultaneously. Because multiple parts of the brain are responsible for these tasks, each individual's recognition network leads each individual to learn in unique ways (Rose & Meyer, 2002). In order to address the diversity of the recognition network, a UDL curriculum provides students with multiple routes and varied options for presentation of concepts and information (Meyer & Rose, 2005). Teachers who understand the importance of the recognition network create lessons and activities with multiple opportunities for learning that address the unique nature in which students learn.

The strategic network oversees mental patterns and allows learners to plan, activate, and monitor their actions (Rose & Meyer, 2002). The strategic networks are located in the frontal lobes of the brain and generate the patterns that guide actions. Similar to the recognition networks of the brain, the strategic network distributes the act of thinking strategically across various modules of the brain. The strategic modules of the brain work in parallel allowing for complex activities to be completed simultaneously (e.g., playing the piano). Strategic processes are also interdependent of one another allowing an individual to engage in distinct behaviors for specific needs (e.g., picking up a ball one way to toss it and a different way to roll it) (Rose & Meyer, 2002). The strategic network identifies a goal or action and what steps must be taken to achieve that goal (Meyer & Rose, 1998).

Differences in the strategic network of the brain are evident in classrooms as students display variability in their ability to perform simple pattern-based activities such as letter formation, spelling, and multiplication, as well as higher-level activities such as planning, hypothesizing, comparing, and contrasting (Rose & Meyer, 2002). Best practices in supporting the strategic network include activating students' prior knowledge, providing models to students, and teaching students to identify patterns (Hardiman, 2001). To support the variability in strategic networks, a UDL framework provides students multiple means to express their learning through different media and styles, multiple opportunities to practice skills, and ongoing feedback (Meyer & Rose, 2005). While teachers can address strategic networks without technology, utilizing technology tools allows students to express their knowledge in ways conducive to the uniqueness of strategic networks.

The third network of the brain is the affective network which evaluates patterns and assigns emotional significance. This network is located directly in the center of the brain and is distributed across many brain modules that influence motivation to learn and engagement with tasks. The affective network allows students to engage in their world in order to maximize learning (Rose & Meyer, 2002). Without the affective network, learners lack motivation, the ability to focus, and the ability to prioritize skills. Influences on the affective network can impact the actions of the strategic and recognition networks (Meyer & Rose, 1998). The affective network uses experiences to engage learners and as experiences become less engaging to students, their ability to work and succeed in school decreases (Meyer & Rose, 2000). Best practices in classrooms supporting the affective network include offering a challenging, yet supportive environment, teaching peer acceptance and social behaviors, and connecting students' emotions to learning through drama, humor, movement, and the arts (Hardiman, 2001). Teachers implementing a UDL curriculum can support the affective network by offering differentiated levels and choices of content and tools, as well as rewards or incentives to increase motivation and engagement (Meyer & Rose, 2005). Classrooms that provide challenging, yet supportive opportunities for students to learn are addressing the affective network.

Research has been conducted specifically on the brain during reading. Positron emission tomography (PET) scans show areas of the brain that are activated during different tasks (Wolfe, 2001) and have revealed that several different parts of the brain are utilized during reading (Meyer & Rose, 1998). Hearing words activates the temporal lobe, while seeing words is mainly focused in the occipital lobes. The parts of the brain that are activated during reading form a network as these active parts work together to perform the action of reading. The recognition, strategic, and affective systems each correspond to different areas of the brain and coordinate many skills. Each learner activates similar areas of the brain to perform tasks, and each person has his own individual "signature" on learning (Meyer & Rose, 1998, p. 6).

Emotions have been found to play a vital part in learning. Emotions, learning, and memory are linked as the different parts of the brain are activated (Rushton & Larkin, 2001). A student must feel emotionally secure in order to engage in learning (Given, 2002). Emotional security can be promoted in schools by avoiding emotional stress through fostering students' self-esteem and giving students control over their environment (Sylwester, 1995). The physiological composition of the brain substantiates the importance of emotional security as more neural fibers stem from the emotional center of the brain into the logical center than vice versa. Thus, emotions contribute to behavior more powerfully than rational processes (Green, 1999; Sylwester, 1995). Research suggests that high levels of stress interfere with learning (Rushton & Larkin, 2001). Students need emotional stability in order to learn and teachers must create classrooms that are nurturing and positive learning environments. Gulpinar (2005) referred to this ideal classroom environment as "Relaxed Alertness" (p. 302) with its positive social climate that is challenging, but non-threatening.

When emotional needs are being met, serotonin is produced by the brain that leads to positive feelings within an individual. In classrooms, this can occur through students feeling included in the group (Gregory, 2005), assigning peer buddies, teaching social behaviors, or other means of building a trusting teacher-student relationship (Hardiman, 2001). Teachers can support students in their emotional systems by providing multiple means for students to demonstrate their knowledge, challenging students at their learning level, providing a supportive and predictable environment, and cultivating students' intrinsic motivation (Gregory, 2005).

In terms of cognition, the debate over nature versus nurture is important when considering the impact of experiences and genetics. Brain development results from a combination of the genetic components of the brain and the way those components are activated through enriching environmental experiences (Jensen, 1998). These experiences are particularly important in the early years of learning. Early experiences can increase neuronal complexity and improve brain function (Bergen & Coscia, 2001). Brain research supports that there are certain times in a child's life when the brain has increased plasticity making it more receptive to learning (Rushton & Larkin, 2001). Research supports that experiences are key in modifying the structure of the brain, and practice has a positive impact on learning. The amount of these experiences has a commensurate relationship with the amount of structural changes within the brain (Bransford et al., 1999). Enriching experiences that maximize brain growth are those that challenge learners, as well as allow for interactive feedback (Jensen, 1998).

Brierley (1987) suggested that birth to puberty is when the brain is at "flood readiness" (p. 110) and is the crucial time to maximize learning. The physiological composition of the brain changes as a result of every new experience. New branches of dendrites are formed that relate new learning to prior experiences and an enriched environment increases cell weight (Rushton & Larkin, 2001). As individuals learn, the structure of the brain adapts and becomes more unique with each additional experience and knowledge (Green, 1999). In her discussion of brain research, Given (2002) refuted the assertion that learning is a nature versus nurture argument. She described the relationship between heredity and environment as a porous one where the two flow into one another in "nearly equal proportions" (p. 6). Teachers are charged with creating positive and enriching educational experiences that increase learning, as well as provide students an environment in which they feel supported and challenged. With its focus on the uniqueness of each student's brain and individual learning strengths (nature), UDL promotes a flexible curriculum within a supportive and positive classroom environment that challenges students to grow academically (nurture).

Brain research and universal design concepts have come into convergence in research involving patients afflicted with Alzheimer's Disease (Zeisel, 2001). Human brains have similar structures that are constantly seeking to make sense out of their environment. People respond better in places they are familiar, while anxiety becomes evident when presented with new or unfamiliar settings. Zeisel (2001) asserted that the brain has developed over time to survive and to fit into its environment. Based on brain research, recommendations were made for universally designed facilities that address the unique needs of certain areas of the brain that may be impacted by Alzheimer's Disease. One example is the frontal lobe and motor cortex of the parietal lobe which provide the body with an awareness of physical limitations and disabilities, as well as self-control and independence. Building designers can universally design buildings to accommodate this area of the brain through the use of rails, accessibility supports in restrooms, and cushioned floors to buffer falls. The hippocampus and amygdala serve to process moods, feelings, and emotions. In designing facilities, this can be done through the use of varied materials and spaces evoking different moods and emotions. The parietal and occipital lobes allow a person to be in the present and retain a cognitive map. This can be accommodated through clearly defined spaces with unique and different characteristics that allow for information to be embedded in the setting rather than in one's own mind. Zeisel (2001) asserted a powerful connection exists between the brain and a universally designed environment that takes into consideration the various brain functions.

Rose and Meyer (2002) asserted, "One of the clearest and most important revelations stemming from brain research is that there are no 'regular' students" (p. 38). Students bring various strengths, weaknesses, and preferences to school, and brain research highlights this variability. Teachers implementing a UDL framework build choice and flexibility into their lessons and activities to ensure that students of diverse learning strengths and needs are not presented with a static and inflexible curriculum. Educators who understand brain research and learning theories can implement instructional strategies that increase student success (Mason et al., 2005). Applying such practices to lesson design and assessment allows the curriculum presented to students to address the diverse strengths and styles they bring to the classroom.

Multiple Intelligence

Gardner (1993) emphasized that educators should better understand how the minds of individual students are different, and schools should be individually-centered to be maximally effective. Gardner suggested that intelligence is multi-faceted and categorized into at least seven types including: verbal/linguistic, logical/mathematical, musical, spatial, kinesthetic, intrapersonal, and interpersonal. The verbal/linguistic intelligence is evidenced by sensitivity to the sounds and rhythms of words, as well as sensitivity to the various functions of language. The logical/mathematical intelligence has core components which include sensitivity to logical or numerical patterns and the ability to reason. The musical intelligence produces and appreciates rhythm, pitch, and timbre, as well as various forms of musical expression. Spatial intelligence involves the capacity to perceive visually and spatially and to complete transformations based on perceptions. Kinesthetic intelligence involves controlling one's body movements skillfully. Intrapersonal intelligence allows individuals to discriminate their own feelings, strengths, desires, and intelligences to guide their own behavior. Interpersonal intelligence allows individuals to respond appropriately to other people's moods, temperaments, motivations, and desires (Gardner & Hatch, 1989). Gardner's multiple intelligences are not meant to promote identifying a student's intelligence and only teaching in that way. Gardner's focus is on broadening perspectives of knowing and thinking and providing alternate ways of learning (Mason et al., 2005).

The uniform teaching practices that are utilized in some classrooms deny success for students because of the lack of focus on students' strengths (Green, 1999). Teachers have tremendous opportunities and obligations to utilize class time effectively to enhance student learning. Brain research (Jensen, 1998; Green, 1999) continually emphasizes the importance of stimulating environments. The most effective teachers will enhance learning by presenting students with a rich environment coupled with meaningful challenges (Green, 1999). Teachers can enhance the learning of their students by creating flexible and engaging instruction that coordinates with each learner's strengths, rather than requiring the learner to adjust to a static and inflexible curriculum (Mason et al., 2005). While educators can debate the efficacy of Gardner's multiple intelligences, many of his assertions are valuable to educators (Green, 1999). Gardner (1993) suggested that students who are successful in school have strengths in critical reading and calculation, and assessments in schools typically focus on those specific skills.

Students learn in different ways and when instruction corresponds to their learning strengths, they can demonstrate their mastery in similarly differentiated means. Effective teaching involves providing differentiated instructional materials and assessments (Tomlinson, 1999). The brain responds to learning situations that provide as many experiences and opportunities for processing as possible. Students must be given time to reflect, make sense of their experiences, and relate them to prior knowledge. Teachers can accomplish this through constructivist or explicit educational activities. However, the focus should be on multi-sensory approaches that allow for differentiated presentation, engagement, and assessment to meet students' diverse learning strengths (Green, 1999). Gulpinar (2005) referred to this classroom philosophy as "Orchestrated Immersion in Complex Experiences" (p. 302) which exists when learners are presented with complex and realistic experiences with ample time for reflection, exploration, and meaningful connection to the real-world. There is great potential in the empowerment of educators to use brain research in redefining how instructional materials are created and utilized in classrooms (Meyer & Rose, 1998).

The application of multiple intelligence theory in the classroom is evidenced when teachers provide multiple choices and opportunities for students to work in different intelligences. Based on the various intelligences in which students best learn, teaching strategies that work for one student may not work for another (Silver, Strong, &

Perini, 2000). Silver and colleagues asserted, “Each intelligence can also serve as a unique and exciting way of focusing on the content students need to learn” (p. 18). A UDL framework coupled with technology innovations allows for greater flexibility in content delivery and assessment that is centered around students’ strengths.

Learning Styles

Current brain research indicates that an individual’s most effective learning style changes depending on the task being performed (Meyer & Rose, 1998). A student may perform some tasks better through analyzing the key components of a concept, while other tasks may be more suited to focusing on the larger concept. Some tasks may be better suited to discussions, some to writing, and some to kinesthetic styles of learning (Green, 1999). A shift has occurred from a focus on "hemispheric dominance" where individuals were thought to have a dominance of either left or right hemisphere that guided their learning to a suggestion of "cerebral asymmetry" which refers to task-dependent differences between the two hemispheres of the brain (Gulpinar, 2005, p. 300). Each hemisphere functions in distinctly different modes with the left hemisphere operating in a linear, logical, sequential, and analytical manner, while the right hemisphere operates in a more nonlinear fashion which processes information more holistically. An individual's hemispheric processing is highly correlated with his learning style (Gulpinar, 2005).

Perkins (1995) examined learning styles and found that instructing students to become more aware of their learning styles helped them behave more intelligently. Similarly, Griggs and Dunn (1995) found that assisting students in becoming more aware of their learning style preferences resulted in increased test scores and a more positive outlook on learning. Teachers should help their students become more aware of their unique learning style and identify their strengths and weaknesses (Silver et al., 2000). Teachers who integrated multiple intelligences with a hierarchy of educational objectives and processes have reported increased confidence in their ability to address students' strengths, differentiate their curriculum, and have seen their students as more successful learners as a result (Noble, 2004). While learners use multiple learning styles throughout their life based on context and demands of the task, most people favor one or two styles over others (Silver et al., 2000).

Individuals need to be challenged in order to learn. Research supports that Vygotsky's theory (1978) of the zone of proximal development (ZPD) is vital for consideration by educators. Mason and colleagues (2005) describe ZPD as "the general cognitive area in which learning occurs" and "the difference between what a student can do on his own and what he can do with the guidance of a teacher or a more knowledgeable peer" (p. 34). The ZPD is the upper boundary of a student's competence and changes based on experiences and learning (Bransford et al., 1999). Every student's ZPD is different, requiring different supports in order to progress. Teachers must be aware of a student's interests and level of functioning so that instruction and level of challenge can be adjusted. If tasks are too difficult, the child will shut down; if tasks are too easy, the student will lose interest (Mason et al., 2005). While most teachers strive to create a pleasant learning environment, the way they instruct can be inherently stressful to students. When teachers require students to receive instruction, perform tasks, and demonstrate mastery in ways that do not correspond to their learning strengths or modalities, they are creating stressful environments for students (Green, 1999).

Research has further demonstrated that an engaged brain is a learning brain (Rushton & Larkin, 2001). The brain's ability to focus and maintain attention is critical to learning and memory (Sylwester, 1995). While common sense tells good teachers that they should keep their students engaged, the support of research only furthers that pedagogical belief. When a learning activity engages students, they are able to overcome significant deficits in their recognition and strategic networks in order to learn (Fink, 1995; Fink, 1998). Students can learn best when engaged in physical and social experiences that are presented in real-life contexts that promote generalization (Rushton & Larkin, 2001). Furthermore, when students are engaged by being presented with information in their most comfortable learning style, they experience increased neural and chemical activity (Mason et al., 2005). Concrete and vivid images have the most powerful influence on a student's brain (Rushton & Larkin, 2001).

Teachers who can combine the research on physiological benefits of an engaged learner with consideration of the zone of proximal development can create lessons that challenge and engage students. Brain research supports the principles of UDL in that every brain has unique patterns of development, and each student learns differently. In order for students to learn best, they need to feel engaged with their learning (Mason et al., 2005). Silver and colleagues (2000) emphasized teachers being aware of their own learning styles because often teachers' learning preferences "dominate our classroom so that learners whose styles are different from our own become disengaged and unmotivated, while the learners whose styles match our own breeze through our assignments easily and without thinking deeply" (p. 36). Students need to be provided with opportunities to work in all learning styles. Technology and multiple media options offer flexible tools that allow teachers to vary their instruction and materials in ways that foster a higher level of student engagement (Meyer & Rose, 2000).

Differentiated Instruction

The standards-based reform movement has infused standards, accountability, and high-stakes testing into the framework of American education. Teachers and schools are forced to balance the "seemingly competing imperatives of meeting high-stakes accountability standards while addressing the individual needs and strengths of diverse learners" (McTighe & Brown, 2005, p. 234). No Child Left Behind (2001) specified that schools must "use effective methods and instructional strategies that are based on scientifically based research" (P.L. 107-110, p. 1473). Differentiated instruction is not a specific model or activity, but rather a "way of thinking about teaching and learning that…challenges how educators typically envision assessment, teaching, learning, classroom roles, use of time, and curriculum" (Tomlinson, 1999, p. 108). Differentiated instruction is based on ongoing assessment, is student-centered, and blends instructional approaches including whole-class, group, and individual instruction (Tomlinson, 2001).

Differentiated instruction first entered public education for teachers of high-achieving students who needed to present more challenging instruction (Hall et al., 2003). Teachers incorporating differentiated instruction into their pedagogy provide multiple means through which students can learn, increase student ownership over learning, and promote collaboration with peers to foster increased learning (Shores & Chester, 2009). While differentiated instruction has very little empirical evidence to support its efficacy in public education, it is receiving increased recognition (Hall et al., 2003).

Teachers implementing differentiated instruction principles design lessons and activities to address tremendous diversity, including students with disabilities, advanced learners, students who are learning English, students from various cultures and economic backgrounds, and students who simply underachieve (Tomlinson et al., 2003). Teachers can differentiate three components of their instruction: content, process, and products (Tomlinson, 2001). Teachers who utilize differentiated instruction implement a wider range of instructional methodologies, utilize various formats of materials and assessments, and provide activities that vary in complexity and content (Wehmeyer et al., 2002).

Given these factors, Tomlinson and colleagues (2003) asserted that much of the recent focus on differentiated instruction is in response to a level of diversity within classrooms that teachers simply cannot ignore. The diversity which teachers must address is compounded by an emphasis on mainstreaming students with disabilities and a decrease in programs for gifted learners (Lou et al., 1996). Differentiated instruction can be successful in meeting the needs of diverse students at all grade levels through continual assessment and goal setting. This assessment data is most effective when it is used to teach students at the level they learn best—just above their functioning level (Shores & Chester, 2009).

Differentiated instruction has emerged as a framework through which teachers adjust instruction and provide choice and flexibility in a learning environment that acknowledges students' diversity, strengths and interests (George, 2005; Anderson, 2007). Tomlinson (2004) defined differentiated instruction as "ensuring that what a student learns, how he/she learns it, and how the student demonstrates what he/she has learned is a match for that student's readiness level, interests, and preferred mode of learning" (p. 188). Tomlinson (2004) further suggested that implementing differentiated instruction in classrooms is valuable because it honors the uniqueness of each individual and how that individual's strengths can contribute to the greater success of the class as a whole. This community approach closely mirrors the greater environment to which students will be exposed upon entering adult life.

Baumgartner, Lipowski, and Rush (2003) utilized differentiated instruction strategies to address students who were struggling in basic phonemic awareness and comprehension skills. The students had documented difficulty selecting appropriate reading materials and a lack of interest in reading. Student deficits were addressed through flexible grouping, increased student choice, increased self-selected reading time, and access to wider variety of reading materials. Students who received differentiated instruction in this manner increased their use of reading comprehension strategies. Second grade students increased by an average of .96 strategies per student, third grade students increased by an average of 3.24 strategies per student, and seventh grade students increased by an average of 5.32 strategies per student. Pre-test/post-test analysis found that all participating grade levels demonstrated an increase in the percentage of students who read at least 31 words correctly. Prior to intervention, only the second grade students had a majority of students reading at or above grade level. After completion of the study, all targeted grade levels had a majority of students reading at or above their grade level.

VanTassel-Baska et al. (2008) conducted a study of classroom teachers' instructional behavior change over the course of three years as they implemented differentiated curriculum units, participated in regular professional development opportunities, and collaborated with university professionals. At the conclusion of the three year study, teachers in the experimental group received higher ratings on a validated research tool in the areas of curriculum planning and delivery, accommodation for individual differences, critical thinking strategies, and creative thinking strategies. Based on the assessment results, the teachers in the experimental group scored significantly higher in every area assessed with a higher pre-post change than those of the comparison teachers. Teachers who stayed with the project for all three years demonstrated strong implementation of the instructional strategies.

Tieso (2005) examined the effect of curricular and grouping practices on students' mathematics achievement through curriculum-based assessment. The study yielded significant differences between the treatment group and comparison group. The treatment group participated in a differentiated curriculum with ability grouping, while the comparison group was exposed to the regular curriculum delivered using the textbook. Pre-test/post-test analysis of mathematics scores of fourth and fifth grade students based on treatment group identified significant differences (F = 22.62, p<.001) with effect sizes ranging from -.10 to .49. Students participating in the highest level of revision to the curriculum experienced the greatest gains compared to other treatment subgroups.

There is an inseparable link between brain research and differentiated instruction. Given the assertion that intelligence is flexible and that there is an endless list of human intelligences (Gardner, 1993), educators strive to create opportunities to enrich experiences, develop many types of intelligences, and provide meaning so each learner's brain can connect new knowledge with something already understood (Tomlinson, 1999).

Differentiated instruction encompasses a variety of approaches and learning activities. In some classrooms, this is done through cooperative learning. Research has suggested that teachers perceive benefits of cooperative learning for special and remedial education students (Jenkins, Antil, Wayne, & Vadasy, 2003). Differentiated instruction is increasingly important as teachers strive to provide meaningful learning opportunities for students with disabilities who are increasingly receiving the majority of their education in general education classrooms (U.S. Department of Education, 2009).

Hall, Meyer, and Strangman (2005) suggested, "The model of differentiated instruction requires teachers to be flexible in their approach to teaching and to adjust the curriculum and presentation of information to learners, rather than expecting students to modify themselves for the curriculum" (p. 154). Techniques such as flexible grouping, effective classroom management, ongoing assessment, promoting active learners, and allowing for flexible representations of learning allow teachers to differentiate their instruction to address the diverse learners in their classroom (Tomlinson, 2001).

Bray, Brown, and Green (2004) suggested that differentiated instruction blends well with technology and “is uniquely suited for not only dealing with the unique learning characteristics of a wide variety of students but also for allowing the teacher to more effectively integrate limited technology resources into the day-to-day activities of the classroom” (p. 54). Many schools struggle in accommodating diverse learners and various learning styles because they rely primarily on print media (Gordon, 2003). The UDL concepts of providing multiple examples, providing multiple media and formats, highlighting critical features, supporting background knowledge, supporting practice, and providing flexible opportunities to demonstrate skills are highly coordinated with differentiated instruction (Hall et al., 2003). Building upon differentiated instruction as a tool through which teachers can address the needs of diverse students, UDL integrates emerging technological tools and capabilities with differentiation to provide teachers and students with greater choice and flexibility in the curriculum.

Technology in the Classroom

As technology use has spread throughout society, the pressure for education to utilize technology tools and produce citizens prepared for the technology age has steadily grown (Coppola, 2004). Edyburn (2006) questioned, "Outside of schools, technology has fundamentally altered how some tasks are completed...but only one way to learn about American history--by reading a textbook?" (p. 21). In some cases, a "technological imperative" drove teachers to use computers "driven by the technology rather than the curriculum" (Coppola, 2004, p.10). In other cases, computer use can best be described as "cosmetic use" where teachers feel that they should be using technology because of administrative pressure or other factors (Coppola, 2004). Kleiman (2004) asserted that in most schools “we have seen a sprinkling of technology into the curriculum” (p. 250). Literature on the efficacy of technology in classroom instruction has been inconsistent, but has yielded information to allow some conclusions in certain content areas and grade levels (Kulik, 2003).

In Indiana, teachers report that their students spend between one to five hours per week using technology (Education Technology Council, 2007). The most common activities conducted on the computer included using drill and practice or tutorial software, producing print products, or conducting online research (Education Technology Council, 2007). Among fourth, eighth, and eleventh graders, using the computer to research and write were the highest rated uses (Coley et al., 1997). Nationally, children ages 8-18 spend more than seven and a half hours per day engaging with media through a smart phone, computer, television, or other electronic device. Many of those children are multi-tasking which allows them to interact with almost 11 hours of media content in that time (Rideout, Foehr, & Roberts, 2010). For the majority of these students, arriving at school means they have to “power down” for several hours and only one-third of high school students think their school is doing a good job of preparing them for the jobs of the future (Project Tomorrow, 2009). Schools are attempting to balance available technology resources with students who are highly engaged with technology that is constantly changing and determine how these forces can influence curriculum and instruction.

Adequately incorporating technology into schools has proved challenging due to several factors, including financial concerns, the need for upgrades and support, and ongoing professional development. Campbell and Algozzine (2005) suggested, "While bringing technology into special education has not been cheap, it has proven to be a worthwhile investment" (p. 749). As technological advances have increased, educational tools have become smaller and more portable with features including speech synthesis and recognition (Silver-Pacuilla, 2006). These technology tools can support differentiated instruction through graphics, software, word processors, internet tools, talking texts, and graphic organizers (Wahl & Duffield, 2005).

Students responding to a NetDay survey (U.S. Department of Commerce, 2005) suggested several ways that they would like technology to be used in schools. These suggestions included learning games, specifically in math and science, as well as virtual worlds where students could witness and experience historic events or different cultures. Students also reported a desire for online classes and online teachers, the ability to complete work, tests, and quizzes online. Project Tomorrow (2009) reported that one-half of elementary school student respondents reported playing educational computer games and one-half of middle school students reported creating slide shows and videos as assessments of their content knowledge. Two-thirds of high school students reported accessing a class website or school portal to access information about their classes. More than 50% of secondary students in middle and high school reported collaborating with their classmates through social networking sites. Twenty percent of students reported using online textbooks or curricular materials, 10% reported getting help from online tutors, and 9% reported listening to podcasts of their class. This study of faculty at various levels of UDL training seeks to identify how frequently various technology tools are being used in classrooms across Indiana and to identify whether there are differences in frequency between faculty members trained in UDL and those with no training in UDL.

Equipping teachers to effectively integrate technology into the curriculum is critical (Coley et al., 1997), yet effective technology integration within instructional practices is dependent on adequate equipment and connections. The availability of technology resources can vary across schools and districts (Smerdon et al., 2000; Consortium of School Networking, n.d.). Even though access to computer technology is improving, the manner in which technology is utilized in daily instruction is not yet linked to the curriculum (Becker, 2000). In a professional development program focusing on the Intel technology curriculum, teachers were found to implement some, but not all, of the technologies that were components of the training program (Navarro, 2008). Teachers are more likely to successfully integrate technology into their classrooms when they see its connection with the curriculum. Integrating innovations into the classroom has been found to be dependent on issues such as the school culture and its support of innovation, the relationship of the innovation to the teacher's existing practices, and the availability of technological resources (Zhao, Pugh, Sheldon, & Byers, 2002).

Research has found predictors of technology integration within the classroom to be attitude, support, and access (Blankenship, 1998). Teachers reported computer use was positive and important and that students enjoyed using computers. Access to computers was found to increase as grade levels increased with primary classrooms (grades preschool to second grade) having fewer computers per classroom than high school (grades 10 to 12). Teachers reported a high degree of support for computer use in classrooms from key stakeholders, including parents and administrators. Gender of respondents was found to be a good predictor of technology use for drill and practice purposes and a very strong predictor of overall computer use. Access and training were found to be moderate predictors of computer skills instruction use (Blankenship, 1998).

Several factors have been identified which affect the use of computers in schools: availability of computers, teacher computer expertise, teacher philosophy and objectives, teacher collaboration and leadership, teacher judgments of class ability, and school socio-economic status level (Becker, 2000). Staples, Pugach, and Himes (2005) identified three factors which contributed to technology integration in urban elementary schools. These factors included school principals and teachers aligning technology to support the curriculum, teacher leadership to guide technology integration, and public/private recognition for technology uses across the school. Staples et al. (2005) suggested that technology integration may be particularly challenging for urban districts which may lack resources available to other districts. However, by focusing on technology specifically as it relates to the curriculum and providing a commitment of professional development resources, technology integration can be fostered.

Recent technology innovations called Web 2.0 applications offer increasingly flexible options that allow for more differentiation. Web 2.0 emerged as a term in 2004 to describe the new web-based tools that exist and allow individuals to not just access information from the web, but to interact, create, and share information (Solomon & Schrum, 2007). Web 2.0 applications offer teachers more opportunities to improve options and accessibility for all students (Grabinger et al., 2008). According to the NetDay Speak Up Survey (Project Tomorrow, 2006), 65% of American students in grades 6-12 indicated that they use email and/or instant messaging every day. In addition, from 2004-2005, the use of a personal website for students in these grades has increased at a rate of 300%. The interconnectedness that Web 2.0 applications provide for students allows for communication and extended learning opportunities beyond anything to which students have previously had access (Solomon & Schrum, 2007).

Research conducted in the United Kingdom (Clark & Dugdale, 2009) has found that technology use among students had a positive impact on their perceptions of their writing skills. The researchers surveyed over 3,000 students aged 8 to 16 and found that 89% believed computers make it easier to correct mistakes and 76% believed computers allow them to present ideas clearly. Almost 60% of students believed that computers allowed them to be more creative, concentrate more, and encouraged more frequent writing. Students who write on a blog were more likely to enjoy writing (57%) than students who did not write on a blog (40%). Students who had a blog and those with their own social networking site displayed increased confidence and considered themselves to be good writers (61% and 56% respectively). While some parents and educators may question the impact that new technological media is having on students' academic skills, this research suggested blogging, texting, and having a social network site increased students' confidence in their writing skills.

Utilizing technology in classrooms has proven effective for students with ADHD in improving oral reading fluency and decreasing off-task behavior (Clarfield & Stoner, 2005). Programs in which students have access to individual computers throughout their day have not only demonstrated improved writing skills, but increased attendance and decreased disciplinary concerns (American Digital Schools, 2006). With approximately 50% of students with disabilities spending the majority of their school day in general education classes (U.S. Department of Education, 2009), more widespread use of technology can assist educators in meeting the requirements of IDEA and providing a more appropriate education to students in their least restrictive environments (Hasselbring & Williams Glaser, 2000).

While technology use in schools is increasing and the opportunities seem endless, technology is less about hardware and software, but more about teachers' beliefs of effective teaching, meaningful learning, and how technology can significantly alter the roles of students and teachers in the learning environment (Windschitl & Sahl, 2002). Some researchers (Anderson & Anderson, 2005; Russell, Bebell, O'Dwyer, & O'Connor, 2003) suggested that for technology to be maximally effective, teachers must engage in more constructivist teaching practices that involve a focus on inquiry-based and student-centered learning. Rakes, Fields, and Cox (2006) found that teachers comfortable with technology and those who technology in their instruction are more likely to demonstrate constructivist teaching practices. Siemens (2004) asserted a theory of connectivism that fuses technology into learning theories and stresses the importance of making connections between information sources. Connectivism suggests that connecting information is a critical activity and allows individuals to learn more. Connectivism also acknowledges the impact that technology has on how learning occurs. Further, technological tools shift how brains work and how people learn and function (Siemens, 2004).

In addition to theoretical frameworks, teacher experience in the classroom is also suggested as a factor that influences technology integration. Teachers newer to the profession are significantly more confident than veteran teachers in integrating technology into the classroom, but have significantly stronger feelings about potential negative impacts of technology (Russell et al., 2003). While newer teachers are more confident in technology, their students use technology significantly less than do the students of more experienced teachers (Russell et al., 2003).

Assistive technology is one format through which technology has been integrated into education. The purpose of assistive technology is not to teach, but to increase access to the curriculum (Anderson & Anderson, 2005; Silver-Pacuilla, 2006). However, access to technology tools is often limited. Wehmeyer (1999) conducted survey research of parents and family members of individuals with disabilities in the use of technology in five areas: mobility technology devices, hearing and vision technology devices, communication technology devices, home adaptations, and environmental control and independent living devices. Survey results indicated that limited access to technology and equipment was a significant concern with additional factors including limited funds, training, information, assessment, and device complexity. While access to assistive technology was limited for many families, 83% indicated they had access to a computer (Wehmeyer, 1999).

While available technologies are seemingly endless, research examining the impact of technology specifically on reading has increased. Strangman and Dalton (2005) suggested great potential for technology to assist struggling readers and asserted, “For every critical reading skill there is a technology with demonstrated potential to help prevent and/or remediate learning failure” (p. 565). Research has found positive effects for computer and software programs incorporating technology that focused on explicit instruction in phonemic awareness (Mitchell & Fox, 2001; Kersthold, van Bon, & Schreuder, 1994). Integrated Learning Systems (ILS) are software programs that provide instruction over multiple grades in basic reading and math. ILS has been found to have minimal impact with outcomes similar between experimental and control groups (Kulik, 2003). Through the use of less explicit teaching strategies that incorporated a multimedia computer program focusing on vocabulary and sentence formation, preschool students have demonstrated significant gains in their phonemic awareness (Heimann, Nelson, Tjus, and Gillberg, 1995). The Accelerated Reader (AR) program assists students in selecting books and then assesses their comprehension using computer-based programs. Three controlled comparisons have found a positive effect of reading development in students using the AR program. Median effect of using the AR program was an increase in reading scores of 0.43 standard deviations which is equivalent to an increase from the 50^{th} to the 67^{th} percentile (Kulik, 2003).

Empirical evidence is lacking in the area of technology use in mathematics instruction (Hasselbring, Lott, & Zydney, 2006). Meta-analysis conducted by Kulik (2003) found that all 16 studies analyzing the use of Integrated Learning Systems (ILS) that utilized computerized math tutorial instruction over several grades yielded higher mathematics scores. Nine of the studies had large enough effect sizes to be considered statistically significant. The median effect of these studies examining ILS programs was an increase in math scores by 0.38 standard deviations which is equivalent to an increase from the 50^{th} to 65^{th} percentile.

Strategies such as text-to-speech have been studied to examine the impact on phonics, phonemic awareness, word recognition, and comprehension. Utilizing text-to-speech provides speech feedback to assist the reader in comprehending the passage being read. The results of research on text-to-speech programs are mixed with some studies yielding positive effects (Davidson & Noyes, 1995; Oloffson, 1992), while others demonstrate no impact of text-to-speech programs over other teaching strategies (Shany & Biemiller, 1995; Lewin, 1997; Lewin, 2000). Positive results have been found in using text-to-speech software to aid in comprehension (Elkind, Cohen, & Murray, 1993).

Not all research has been supportive of the infusion of technology into education. Ferneding (2003) suggested that the educational reform movement that has occurred since the 1980s has furthered instructional technology because of a fear of American weakness in global competition. This has created a “technocentric” (p. 230) environment in which policy elites further a view of technology inevitability. Ferneding (2003) questioned the “overarching technological utopianism” (p. 1) and that “electronic technologies ironically could simply reinforce some of the worst aspects of the existing educational system” (p. 3). Such factors as a school’s culture and community, teacher perceptions, and the availability and quality of technology are critical factors. In Ferneding’s view, teachers often strive to gain technology and then neglect fundamental pedagogical issues. In Indiana, survey results of teachers and administrators supported this assertion as increases in the amount of technology in schools had not translated into significant changes in instructional practice (Education Technology Council, 2007).

Ferneding’s research (2003) presented two case studies involving an elementary school and a middle school in the technology-rich environment of Silicon Valley, California. Teachers identified concerns with technology including disparity between poor and affluent schools in availability of technology and a resistance to technology adoption. Time, fear, and other priorities (academic skills, social skills, behavior problems) limited teachers’ acceptance of technology. Some teachers expressed concerns regarding the impact of technology on social skills, including dehumanization, isolation, and loss of socialization. Most participants in this study offered misgivings about the infusion of technology in schools and a general “technological pessimism” (p. 238) both about education and the larger society. Ferneding (2003) suggested educators reflect on appropriate electronic technologies that address the context and uniqueness of their school.

The factors addressed by Ferneding (2003) correspond to the assertion of Peck, Cuban, and Kirkpatrick (2002) that even with the dramatic increases in technological capabilities available in schools, the experiences of students today are largely similar to the experiences of previous generations of students. Over 50% of elementary and middle school teachers reported themselves as nonusers of computers for classroom instruction (Peck et al., 2002). A survey of fifth grade students indicated that they averaged about 24 minutes per week on the computer, while eighth grade students reported 38 minutes per week (Cuban, 2001). Cuban (2001) concluded that technology had not led to changes in teaching practices and had not been effectively infused into the academic repertoire of most schools or teachers.

A challenge in incorporating technology effectively into the classroom is infusing innovative strategies and programs into teachers' daily practices. Research conducted by Jaber and Moore (2002) surveyed teachers and found that 67% used computers for instructional purposes. Even with increasing numbers of computers available in many schools, access plays a large role in the frequency and manner in which technology is incorporated into daily activities. Eighty-six percent of teachers surveyed reported that they received most of their technology training from peers. Of teachers who had access to computers, 67% used them for instruction (Jaber & Moore, 2002). In Indiana, 47% of teachers and 46% of principals indicated that digital technology is very important in their daily instruction (Education Technology Council, 2007). However, 48% of teachers indicated they did not consistently integrate technology in their classrooms (Education Technology Council, 2007).

Fullan (2000) placed technology and teacher pedagogy into perspective as he asserted that technology can provide great amounts of information. However, technology itself does not understand pedagogy or how to create an environment conducive to students' inquiries and construction of knowledge. Technology is only as effective as the teacher who can determine how to infuse it into daily activities in meaningful and productive ways (Fullan, 2000). The constant evolution of technological tools and capabilities leads to difficulty in the pace of innovation versus the pace of implementation as teachers become discouraged in implementing products that are too complex to easily integrate into classrooms (Silver-Pacuilla, 2006). Fullan (2000) further challenged teachers to go beyond using technology within their own classrooms, but to share what they are doing with other teachers. This focus on collaboration is critical as increasing numbers of students with disabilities and other diverse learners are taught in general education classes. Technology can be powerful in meeting the needs of all students when it is used in the context of research-based practices, effective professional development for teachers, and strong administrative support (Gordon, 2003).

Several critical areas have been identified through experience and synthesis of research (Bitner & Bitner, 2002) that facilitate an environment in which teachers are allowed and encouraged to successfully integrate technology into the curriculum. Sixty-four percent of Indiana teachers reported lack of teacher proficiency in using technology as the biggest barrier to effective use of technology in teaching and learning (Education Technology Council, 2007). Teachers have a fear of change, and implementing new strategies, particularly technology, into a classroom is a significant change for a teacher (Bitner & Bitner, 2002). Basic training is critical as teachers need to have an understanding about technology and how to successfully utilize the tools available within their school (Jaber & Moore, 2002). Personal use is an important factor as teachers become more accustomed to using technology to meet some of their daily management needs, including e-mail, gradebooks, research, lesson planning, and other activities

(Russell et al., 2003). As teachers become more comfortable using technology in these situations, they will gain confidence in incorporating technology into instruction.

Teaching models and ongoing support are important to foster motivation as teachers observe and experience the different options available for large and small group instruction, problem solving, drill and practice, and other instructional activities (Bitner & Bitner, 2002). Schools must foster a focus on learning, and teachers may need to reexamine their attitudes and perceptions about the roles of teachers and students. Technology fosters a different dynamic between teacher and student and many teachers will need support as they embark on a different philosophical viewpoint (Bitner & Bitner, 2002). Teachers who adhere to a more constructivist pedagogy were found to be more likely to integrate technology into their classrooms than those teachers who adhered to more traditional pedagogical methods (Ravitz, Wong, & Becker, 1999). Other researchers (Rice, Wilson, & Bagley, 2001) have found that over time, technology integration can lead teachers to change practices from a traditional/direct instruction pedagogy to a more student-centered/constructivist pedagogy.

Leadership plays a key role in technology integration (Anderson & Dexter, 2000; Silver-Pacuilla, 2006; Solomon & Schrum, 2007). Building consensus and a shared vision helps to promote technology integration among teachers, but also helps to sustain technology funding within a school (Consortium for School Networking, n.d.). Administrative support is critical in determining whether teachers integrate technology, and administrative acknowledgement of technology integration provides needed support of teacher innovation (Sandholtz, Ringstaff, & Dwyer, 1997). For a school administrator to lead his or her staff towards a greater utilization of technology requires a solid understanding of change processes and a strong vision (Solomon & Schrum, 2007). The Microsoft Corporation (2008) has created Education Competencies specifically for school leaders seeking to guide schools in meeting many of the same mandates for which business leaders are striving. These include individual excellence, organizational skills, courage, results, strategic skills, and operating skills.

A school administrator is charged with ensuring that the climate is conducive to learning and supportive of innovative uses of technology (MacNeil & Delafield, 1998). A school leader must ensure that teachers are aware of technological tools, how they can be used within classrooms, and what impact such strategies can have on student achievement (Silver-Pacuilla, 2006). Demeter (as cited in Shores & Chester, 2009, p. 163) stated,

> Building principals are key figures in the innovation process. Where they are both aware of and sympathetic to an innovation, it tends to prosper. Where they are ignorant of its existence, or apathetic, if not hostile, it tends to remain outside the bloodstream of the school.

The school climate must encourage teachers to attempt technology use in their classrooms and not be afraid of failure. Change occurs slowly in education (Hehir, 2009). Motivation is critical to technology implementation as teachers embark on change, and administrators must monitor school structure, time constraints, and defects in technologies which can hinder technology implementation (Peck et al., 2002). While teachers acknowledge a principal's support as an important factor in technology integration, survey results have indicated that administrative support factors were not linked to an increase in teachers' use of technology (Navarro, 2008).

Administrators play a critical role in supporting teachers by aligning technology resources to foster its infusion throughout the curriculum and prepare students for the digital society in which they live (Garland, 2009-2010). Seventy-five percent of school administrators and 50% of teachers reported that mobile learning devices are beneficial for increasing student engagement. One in three administrators and one in four teachers reported that mobile technology can help personalize learning, develop critical thinking skills, and build communication and teamwork skills. One-half of administrators and one-third of teachers reported that using mobile devices in school prepared students for working in the world (Project Tomorrow, 2009).

Technology integration is a daunting task with issues such as time for staff to explore technology and financial resources often limiting what can be accomplished (MacNeil & Delafield, 1998). Other impediments include personnel resources and adequate planning time (Bitner & Bitner, 2002). School leaders have failed to convey high expectations about the integration of technology into schools, and systemic adoption of technology to enhance learning has yet to be achieved (Education Technology Council, 2007). While UDL is about more than technology integration, the technological tools available today provide a higher degree of flexibility than at any previous time. Without intentional and proactive decisions about the use of technology to accommodate individual differences what results is “simply a happy coincidence between the use of technology and new tools that students enjoy” (Edyburn, 2010, p. 36). UDL presents technology use within the context of existing school reforms, including differentiated instruction, cooperative learning, learning styles, and brain research. UDL provides a framework through which these efforts can coalesce with technology to provide a structure to enhance technology integration and flexibility within the curriculum. Kleiman (2004) suggested profound implications when new technology tools are fully incorporated into the curriculum and take technology use beyond peripheral.

Universal Design for Learning

Universal Design for Learning (UDL) stems from the universal design movement in architecture where it was found to be more cost-effective and aesthetically pleasing to conceive, design, and construct buildings to accommodate the widest range of users (Mueller & Mace, 1998). King-Spears (2009) elaborated on the core principles of the universal design movement and how they can be applied within schools. Flexibility of use is evidenced when teachers design instruction taking into account student choice and optimum learning style. Equitable use is seen in schools through the use of digital texts that take the static print of a standard textbook and make it more accessible while targeting key facts and relationships. Perceptible information as a UDL principle can be applied through the use of various reinforcements of content including illustrations, tactile options, and visual representations. Tolerance for error can be seen in many software programs that provide students with immediate feedback or reinforcement of skills depending on student responses within the software. Simple and intuitive use is evidenced in graphic organizers which assist students in building background knowledge and organizing new terms and vocabulary in a more understandable visual presentation. Low physical effort can be applied to classrooms through a variety of methods that make the instructional materials easier for students to access and manipulate. King-Spears (2009) asserted that size and space for approach and use is one of the most often violated UDL principles. Teachers must ensure that their instruction and content is accessible through appropriately sized text being presented on boards, presentations, or other media. Similarly, language used in classrooms should be clear and focused in targeting critical information necessary for all learners.

Universal Design for Learning is a fairly new framework and while there has been some research conducted on UDL in assessments, there are limited empirical studies examining how UDL is applied in classrooms (Spooner, Baker, Harris, Ahlgrim-Delzell, & Browder, 2007). Many authors and researchers discuss UDL as a promising approach (McGuire, Scott, & Shaw, 2006; Pisha & Stahl, 2005; Pisha & Coyne, 2001; Hehir, 2005), but most base this assumption on their support of the principles and goals of UDL. By incorporating the principles of universal design with innovative findings of brain research and principles of differentiated instruction, Rose and Meyer (2002) suggested three key principles of UDL. First, to support the recognition networks of the brain that receive and analyze information, information must be presented in multiple and flexible methods. Second, to support the strategic networks of the brain, which plan and execute actions, learners should be provided with multiple and flexible methods of expression. Finally, to support the affective learning networks, which evaluate and set priorities, learners should be provided multiple and flexible options for engagement. Rose and Meyer (2002) emphasized the one common recommendation of these principles is to provide students with more options.

By incorporating knowledge of the three brain networks into their daily lessons and practices, educators have found that UDL and differentiated instruction support one another (Hall et al., 2005). Much like differentiated instruction, UDL is not a specific strategy or model, but a framework through which instruction is presented and learning occurs. Hall et al. (2005) suggested, "When combined with the practices and principles of UDL, differentiated instruction can provide teachers with both theory and practice to appropriately challenge the broad scope of students in classrooms today" (p. 162).

While critics of technology in education (Cuban, 2001; Peck et al., 2002) assert that the growing expenditures in educational technology have yielded little benefit to teachers or students, UDL is less about technology and more about flexibility in instructional planning and presentation. UDL simply acknowledges that the technology tools available to educators offer greater accessibility and flexibility in teachers' pedagogy (Rose & Meyer, 2002; King-Sears, 2009). What distinguishes UDL from other technology-driven educational initiatives is its focus on using technology to infuse choice and flexibility into the classroom. UDL encourages teachers to use multiple methods, approaches, and technological tools within their instruction (Harac, 2004). Utilizing a UDL approach, teachers can use digital media and technology to provide multiple options and flexible opportunities, while also providing means for relevant and timely feedback (Meyer & Rose, 2000).

Ketterlin-Geller (2005) reported on several steps that were taken to create a universally designed third-grade mathematics test. First, test items were clearly written and designed to assess only the core content being studied. Extraneous information was removed and test-takers were allowed the flexibility to choose a response mode most suitable to their needs. The test was administered on the computer with embedded supports including practice items and pages that were easy for students to navigate. Multiple-choice questions were utilized which allowed students to select responses using the computer mouse or keys on the keyboard. Questions and answers were available in written and auditory formats, while directions were written using simple vocabulary and a large font to increase readability. Several steps were taken to ensure the test reflected the needs of the maximum number of students, including pilot testing, grade level content review, reliability checks, and focus groups.

Dolan et al. (2005) critiqued the results and accuracy of current large-scale assessments which are undermined by access barriers for students with disabilities. The authors acknowledged that testing accommodations have made some improvements, but a more flexible and individualized approach is needed. Their research applied UDL principles to a computer-based test delivery tool that provided students with a flexible and customizable environment. High school students were given a U.S. History and civics test via traditional means with paper and pencil and a computer-based system with optional text-to-speech. This mixed methods analysis included test scores, student surveys, structured interviews, and field observations. Students answered 65.3% of questions correctly when assessed on computer-based test, while only 58.7% of paper and pencil test questions were answered correctly (effect size = .49 and not statistically significant). Differences were found between long and short reading passages with students scoring 22 percentage points higher on long passages assessed on the computer-based test than the paper and pencil test (effect size = 0.6 is statistically significant). The results provide preliminary support for the benefits of digital technologies in creating assessments that are more individualized, fair, and accurate in assessing the knowledge of students. Through qualitative analysis, the researcher found that 60% of students thought they performed better on the computer-based test over the traditional paper and pencil assessment.

Pisha and Coyne (2001) summarized a research project that displayed the impact of applying UDL to a classroom. Observations were performed in a classroom in which students received weekly lists of twelve terms. The assignment was for students to read a portion of their textbook, find the terms, and write down each definition. Many students with learning disabilities struggled with the text and were unable to read the words, skim, or paraphrase. Students were shown the digital form of the text and the *Find* feature of Microsoft Word which allowed them to locate any term in the text and copy the definition into a word-processor format. This tool allowed the students to complete the task in a much shorter amount of time. This experience demonstrated to the classroom teacher that both the original assignment and the assignment utilizing the computer demanded very little from students and could be completed with minimal time and attention. The researchers collaborated with the teacher to create assignments that were more challenging and thought-provoking for students.

Dalton, Pisha, Eagleton, Coyne, and Deysher (2002) completed a three-year study in which they examined the impact of computer-supported strategy instruction for improving reading comprehension skills of struggling readers at the middle school level. UDL principles served as the foundation of the “Thinking Reader” program developed by Dalton and colleagues (2002). Teachers in the experimental group presented their students with access to text-to-speech features, embedded strategy prompts, an electronic work log to monitor progress, and opportunities to choose and control aspects of their learning environment. Teachers in the control group taught reading strategies to their students without the use of computers. Students who read the computer-supported novels gained approximately .53 grade equivalents, while those who participated in traditional instruction gained approximately .2 grade equivalents (significant at $p<.05$ level). The researchers concluded that these statistically significant results "contribute to a small, but growing knowledge base on...the potential of digital text to support struggling readers' comprehension of age-appropriate novels and use of reading strategies" (p.4). Digital text allows struggling students to bypass many of the problems they experience in typical text. This is accomplished by providing appropriate strategy prompts when necessary, supporting knowledge acquisition to ensure that all students can access the curriculum, and engaging students in the learning process (Dalton et al., 2002).

Meo (2008) found that upon completion of a UDL training process with high school faculty entitled PAL (Planning for All Learners), teachers shifted their focus for failing classes from students to inherent problems with the curriculum. A significant component of the PAL process involved collaborative teaming between the special education and general education teacher. Upon completion of the process, both teachers reported benefits of joint curriculum planning, including stronger use of research-based practices and an increased ability to customize their instruction to meet the needs of the diverse students in their classes.

In order for a UDL framework to be fully implemented and embedded into instruction, flexibility and adaptability must be built into lessons from their creation. Lessons should “envision many ways of demonstrating knowledge and skill, recognizing content, and engaging with the lesson” (Jackson & Harper, 2005, p. 107). Spooner et al. (2007) examined the effect of a one-hour UDL professional development training on lesson plan development. Participants in the experimental group received strategies to remember UDL concepts, as well as explicit examples of how to include students with disabilities in the general education curriculum. This study included both general education and special education teachers and was designed as a pretest-posttest experimental group design with randomly assigned control group. In addition, a scoring rubric was created to assess integration of UDL principles into lesson plans. The results indicated that a one hour training enabled both groups of teachers to develop lesson plans that included a student with a mild or severe cognitive disability. Teachers in the experimental group demonstrated significant growth from pre-test (M = 0.98) to post-test (M = 3.34), while teachers in the control group demonstrated no difference between pre-test and post-test (M = .077). Lesson plan analysis demonstrated significantly modified instruction from teachers in the experimental group based on UDL principles.

Dymond et al. (2006) utilized case study methodology and participatory action research to analyze the impact of UDL to improve the education of students with significant cognitive disabilities (SCD) who were being taught in a high school science course. The intervention consisted of support and professional development from a university research team in redesigning a science course. Following the intervention, there were several notable findings. First, the general education teacher had greater ownership in the instruction of students with disabilities. Second, the special education co-teacher viewed his role as less specialized and less focused on adapting materials for learners since the majority of the curriculum was already adapted. Following the intervention, the special education teacher's role focused more on training of support staff, planning instruction, collaborating, and training the general education teacher so that each student's individualized goals were embedded into lesson plans. The most significant impact of the UDL intervention was the improved social interactions of the students with SCD with others in the class. Other positive effects that impacted students with SCD included an increase in class participation, student responsibility, work completion, grades, and summative test scores. The team also identified that some of the changes made to the curriculum to address students with SCD enhanced the learning of other students in the class. School staff identified the most helpful aspects of the UDL intervention as being the detailed, formal lesson plans and team planning.

UDL strategies have been found to substantially increase overall mean scores on spelling assessments in a pilot study conducted in an elementary resource room for students with learning, social, and attention problems. UDL was incorporated into spelling lessons by creating multi-sensory centers which activated students' visual, auditory, kinesthetic, and tactile senses and including more opportunities for access and participation within spelling activities. Students taught using only direct instruction had mean scores of 55.3, while students taught with direct instruction and UDL had mean scores of 90.5 (Metcalf, Evans, Flynn, & Williams, 2009).

Research conducted by Abell (2006) specifically examined administrative attitudes of special education directors and factors in implementing UDL within the state of Kentucky. The study found significant cost factors associated with UDL as districts acquired curriculum in digital formats and technology infrastructure. However, these cost factors were not significant predictors. There was no significant relationship between the core UDL knowledge of administrators and the special education population size.

UDL has been found to have an impact on the perceptions of students. Kortering, McClannon, and Braziel (2005) presented research from two high schools in which teachers participated in two to four-day training sessions on UDL. Subsequently, students in those classes were surveyed and reported “strong levels of effectiveness, utility, and satisfaction related to the UDL interventions compared to their other academic classes” (p. 3). Both general and special education students reported favorably regarding UDL and 90% of respondents reported a desire for more access to UDL interventions. The authors asserted that one of the significant implications of the study is that UDL “is best viewed as a tool for changing how teachers think in terms of curriculum access and student success” (p. 4).

UDL has been found to have an impact on student perceptions of their learning environment, as well as teacher perceptions of student engagement. Student interviews and surveys indicated that when given choices in topic, presentation, and expression in classroom projects, students reported substantially more engagement. Among teachers, there was a correlation between student engagement and the quality of work being submitted (Coyne et al., 2006)

Johnstone (2003) examined the impact of universal design on large-scale tests both on student performance in mathematics and student response to a universally designed assessment. Each student in this study was administered both a traditional test and a universally designed test. The results suggested that 155 of the 231 students (67%) had significantly higher scores on the universally designed test. Fifty-one students scored lower on the universally designed test, and of those, only 17 scored lower at a statistically significant level. The difference in mean scores between the traditional test and the universally designed test was statistically significant. There was a small to moderate effect on test scores (.39 standard deviations) as a result of test design.

Following the testing period, Johnstone (2003) interviewed those students who scored 1.5 standard deviations higher on the universally designed test. Students indicated that they recognized material better that had been presented according to UDL principles and felt the vocabulary and print of the universally designed test was more readable. Students also acknowledged that having unlimited time to answer questions directly on the answer sheet (as opposed to bubble sheets) was a beneficial aspect of the universally designed measure. The author suggested that with the mandate of increased student participation in assessments under NCLB, there must be strong efforts to construct tests that are accessible and non-biased (Johnstone, 2003).

Acrey, Johnstone, and Milligan (2005) conducted a case study in which they examined the feasibility of using key elements of universal design in study guides and tests at the middle school level. The school represented a high-risk population consisting of low socioeconomic status, more than half English language learners, and a high number of students with disabilities. The school's leadership had embraced universal design and the project involved three phases. Teachers first became familiar with universal design philosophies. Next, the teachers developed study guides based on those philosophies, including graphic organizers, increased accessibility to content, increased readability, and increased cultural relevance. Finally, the study guides were examined against the criteria designed by the school to address access and critical information. All fifty-one of the school's teachers incorporated some type of change toward universal design in their study guides. Surveys of teachers found positive results, including better on-task behavior, better comprehension of materials, and more cooperative students.

There is a growing research base on the implications of universal design in higher education which is often referred to as Universal Instructional Design (UID). Hatfield (2003) conducted a qualitative analysis of university personnel who participated in professional development workshops founded on the principles of universal design. Overall, most participants were attracted to some of the universal design aspects. Brothen and Wambach (2003) utilized universal instructional design in presenting a computer-based psychology course and found that it allowed faculty to monitor students more quickly and efficiently so that interventions could occur when needed. Students with special needs required very little additional support and nothing within the classroom distinguished students with disabilities and those without disabilities.

Several states have integrated UDL into their education policies (Harac, 2004). State-wide UDL initiatives are being implemented in Kentucky, Ohio, New York, and California (Muller & Tschantz, 2003). In Kentucky, evaluations by teachers following a year of training and application of UDL principles in their classrooms revealed significant improvements in their students' ability to stay on-task, work independently, interact with teachers, improve self-concept, and maintain an interest in learning. Teachers also indicated their students' use of the Internet increased dramatically since text-to-speech capabilities allowed all websites to be accessible. In synthesizing strategies and barriers across these state initiatives, Muller and Tschantz (2003) reported that at least three states suggested that successful UDL initiatives require vision and leadership at the state level, buy-in from key stakeholders (principals and superintendents), funding, and legislation prompting publishers to increase digital media. When examining barriers to implementation, three states reported lack of funding and teacher resistance to learning new technologies.

Project Forum through the National Association of State Directors of Special Education recently conducted surveys of six local education agency (LEA) representatives who were identified in five states by recommendation from their state directors as having effectively incorporated UDL principles (Sopko, 2008). These respondents indicated that upon implementation of UDL principles, LEAs saw the value beyond special education and applied UDL to all students. Most respondents had found significant success with fostering teachers' adoption of UDL principles without a district mandate. However, some respondents indicated general education support was a key to integration, and most respondents suggested implementing UDL slowly (Sopko, 2008). Technology supports available at each LEA varied with students-per-computer ratios ranging from 1:2.5 to 1:6. A concern with regards to the practical application of UDL principles was that consistency among teachers was variable. However, respondents felt that building administrators had established a culture where creativity and risk-taking was encouraged, and teachers were using more equitable and flexible activities for instruction (Sopko, 2008). Respondents identified administration as critical in supporting teachers in implementing UDL. Several benefits of UDL implementation were identified, including increased student learning, improved performance, improved test scores, improved behavior, and increased engagement (Sopko, 2008). Similarly, the Consortium for School Networking (n.d.) summarized 2004 survey research which indicated that visionary leadership was a more critical factor in driving technology change in schools than was school budgets.

Summary

While long-term empirical studies examining the impact of UDL have not yet been conducted, the principles of UDL encompassing brain research, flexibility in instruction and assessment, and differentiation have a strong and growing research base. Hehir (2005) asserted that UDL is “a giant step away from the classic retrofitting model of education experienced by many students with disabilities” (p. 99) and has as its goal “minimizing the impact of disability and maximizing the opportunities to participate" (p. 109). Even for students with more significant intellectual disabilities who are participating in the general education curriculum, teachers incorporating the principles of UDL into their instruction and assessments are utilizing one of the "primary means to ensure such access" (Wehmeyer, Smith, & Davies, 2005, p. 314). Innovative practices that incorporate brain research, differentiated instruction, and technology hold much potential in providing flexible instruction and assessments to a wide array of students.

Since the passage of the Education for All Handicapped Children Act in 1975, educators have been challenged to meet the needs of students with disabilities in public schools. As the focus has shifted from access to progress in the general education curriculum, collaboration between general education and special education has been imperative to ensure the success of students. Innovative practices, coupled with collaboration between general education and special education teachers, equip schools to meet the needs of students with disabilities in the general education classroom (Campbell & Algozzine, 2005). UDL combines innovation and collaboration to provide a framework that meets the needs of all students through inherently flexible and adaptable activities. The incorporation of UDL principles into classroom environments should be characterized as subtle and integrated with the goal of accommodating the widest range of students possible (Meyer & Rose, 2000).

Technology is change. Fostering an environment in which teachers can exceed expectations and embrace technology as a meaningful tool to change how they instruct, engage, and assess their students requires leadership. Fullan (2000) indicated that school leaders can expect successful change in student performance in an elementary school to take three years, while six years is the expected time frame for a secondary school. This knowledge of the change process is confounded when technology is incorporated because of the lack of time, professional development, and inhibition of the digital immigrants (Prensky, 2001) that make up much of the teaching force. When these factors couple with teacher overload and reform opportunities that often confound or even contradict one another, the efforts of reforming educational practices is hindered (Fullan, 2000). The benefit of a UDL framework is that it unites many of the various educational reform movements under a common vision designed to increase choice and flexibility within the curriculum.

The proposed study seeks to identify perceptions of faculty at various levels of UDL training, as well as factors that contribute to technology integration. Most empirical research in the area of UDL has focused on the universal design of assessments (Dolan & Hall, 2001; Thompson et al., 2002; Johnstone, 2003; Dolan et al., 2005). Because UDL is a relatively new framework, there is little empirical evidence of how UDL has impacted teachers' daily instruction, assessment, and perceptions of including students with disabilities in the general education classroom. This study will seek to address these issues and contribute to the growing research base surrounding UDL.

CHAPTER THREE

Methodology

Purpose

The purpose of this study was to investigate the perceptions of school faculty and what differences exist between the perceptions of school faculty at various levels of UDL training. Exploratory analysis was conducted examining differences between those who have completed participation in a Universal Design for Learning professional development program (CT), school faculty currently participating in the same UDL program (CIT), and school faculty who did not participate (NT). This study represented mixed methods research including both quantitative and qualitative analyses of respondents' perceptions (Johnson & Onwuegbuzie, 2004). Analyses compared the perceptions of respondents at various levels of participation in a state-wide professional development opportunity in Universal Design for Learning. A quantitative analysis of school faculty perceptions was completed and specifically focused on the impact of UDL training on faculty perceptions of the inclusion of students with disabilities into the general education curriculum. Further analysis identified how teachers use technology to differentiate instruction and what critical factors were identified by school personnel that positively impact technology integration in the classroom. Additionally, analysis was conducted on faculty perceptions of student engagement. One open-ended question was presented to allow for qualitative analysis which examined central themes through percentages and frequency of responses.

Survey research was conducted that compared the perceptions of faculty that have completed participation in all three years of the state-sponsored UDL project, school personnel currently in year two and three of the project, and school personnel who have not participated in the UDL project. Faculty members in year one of participation were not included in this study as they had limited training in UDL at the time of survey distribution. Analyses were also conducted that compared respondents' perceptions based on classification as administrator or teacher, as well as general education or special education. These analyses combined CIT and CT respondents into a UDL trained respondent group. This group was compared to those respondents with no UDL training (NT).

Sample

Since 2003, the Indiana Department of Education Center for Exceptional Learners has sponsored a statewide initiative to support Universal Design for Learning. School districts apply to participate in a three-year grant in which they receive professional development, on-site support, and technology supports through the Partnership for Assistive Technology in Indiana Schools (PATINS) Project. The UDL grant initiative has as its main goal to transform how lessons are developed and taught, and support all the other general education and special education initiatives occurring in schools (Samuels, 2009). Other goals of the UDL initiative are to assist local educational agencies in:

- Beginning to build the capacity for Indiana planning districts to implement Universal Design for Learning (UDL) principles to remove barriers to learning for all students, including students with disabilities.
- Beginning to create awareness of brain research to understand the learning brain for analyzing students' individual strengths and weaknesses and understand their individual differences.

- Beginning to create awareness of how to reconcile educational standards with student diversity by separating the purpose of a standard from the methods for attaining it.
- Beginning to create awareness of Universal Design for Learning (UDL) technology supports for selecting and devising flexible methods and materials that will minimize learning barriers and expand educational opportunities for all students.
- Beginning to create awareness of how to use the Universal Design for Learning (UDL) framework for designing ongoing student assessment.
- Beginning to create Universal Design for Learning (UDL) guidelines, strategies, and learning modules for other Indiana schools interested in implementing UDL principles in classrooms (PATINS Project, n.d.).

As part of the application process, prospective teams submitted a letter of support from their district's superintendent or other appropriate decision maker which contained his or her support of the building level team and a commitment to allow the team release time for professional development opportunities. This letter also included the superintendent's commitment to support the pilot site with technology infrastructure to implement UDL strategies.

Professional development was a critical component of this grant initiative as teams became more knowledgeable in UDL principles and more skilled in applying them in classrooms across the state. Mandatory activities for all teams included an online book study of *Teaching Every Student in the Digital Age* (Rose & Meyer, 2002) and two days of intensive professional development in year one that focused on the principles of UDL.

An additional one day collaborative meeting was required in the spring of the first year which allowed pilot sites to share successes and areas for improvement. Another day of training was required in the second and third years for teams to share their work with other teams. Throughout the grant cycle, building teams also had access to optional professional development opportunities offered through the PATINS Project.

UDL teams were required to engage in activities that demonstrated their increased knowledge and application of UDL principles. Each participating team developed an action plan for implementing UDL in the areas of literacy or math with final drafts submitted by the end of the first year of the grant cycle. Additionally, each participating team was required to submit an update on their action plan progress accompanied by student data. Technology surveys were completed by team members, as well as students served through the grant initiative. Update reports were submitted to the PATINS Project once each semester in the second and third years of the grant cycle. At least once each semester in years two and three, pilot sites submitted a learning module/lesson plan that reflected UDL strategies. Participants agreed to share these products with other UDL teams and allow them to be posted on the PATINS website for access by other interested individuals.

Support from the PATINS Project consisted of providing professional development opportunities, as well as technical support to teams. Regional staff employed by the PATINS Project were available to assist schools in implementing UDL. Once selected for the UDL program, teams requested technology supports (software and hardware) which assisted in implementation of their UDL action plans. These supports were provided by the PATINS grant and after successful completion of the 3-year grant cycle, schools retained these items for their use. In addition to funding these purchases, PATINS staff made at least two scheduled site visits per year of the grant cycle. During these visits, pilot teams reflected on and refined their action plans. These meetings also defined success in terms of standards for learning, tools for measurement of success, and data collection and evidence to assess effectiveness of their projects.

Participants

This study involved survey research that analyzed the perceptions of school faculty, including teachers and administrators. Technology personnel and special education related services staff, including occupational therapists and speech therapists, were included but were asked to classify themselves as general education or special education personnel. Respondents were divided into three groups based on their level of participation in a statewide UDL grant initiative. The first group consisted of faculty that had completed participation in all three years of the UDL program (CT). The second group consisted of faculty currently participating in year two or three of the program (CIT). The third group consisted of faculty from the same schools who had not participated in the UDL grant program (NT).

Further analyses of each variable were conducted that examined differences in respondents' perceptions based on their categorization as administrator or teacher. Additional analyses were conducted examining perceptions based on respondents' categorization as general education or special education. These analyses combined CIT and CT respondents into a UDL trained respondent group. This group was compared to those respondents with no UDL training (NT).

These analyses allowed for distinctions to be made between perceptions of school personnel at varying levels of UDL knowledge and implementation. This study sought to identify how UDL training impacted the perceptions of school personnel in striving to meet the needs of diverse learners through analyses of school personnel at varying levels of UDL implementation. Participants in this study represented 50 schools from 33 school districts across Indiana. Schools represented in this study consisted of 21 elementary schools, 27 secondary schools (including middle, junior, and high schools), one elementary/middle school, and one special education school for grades kindergarten through twelfth grade (see Table 1). Teams at each school applied for and were selected to participate in the UDL initiative. Applications were reviewed and selections made by the PATINS staff. In order to apply for participation in the UDL project, school teams identified four to six school faculty members (i.e., classroom teacher, instructional technology manager, special education teacher, curriculum development director/teacher, assistive technology specialist) and a school administrator to serve as their UDL team.

Table 1

Program Classification of Participating Schools

Program Type	Number	Percentage of Group
Elementary	21	42%
Secondary	27	54%
Elem/Middle	1	2%
Sp Ed K-12	1	2%
Total	50	100%

Note. Secondary includes junior, middle, and high schools

Thirty-four schools have teams that have completed the entire three-year cycle. Sixteen schools have teams that are currently participating in the project. The population for this study included the entire faculty from all 50 schools. This allowed for a census of all faculty members, including both those who had some level of UDL training and their colleagues from the same schools with no UDL training. The sample group of personnel who have completed or are participating in UDL training consisted of 300 participants: 77 administrators, 85 special educators, and 138 general educators.

The second group of participants in this research was individuals who had not participated as team members in the UDL pilot initiative. These individuals were school personnel at the same schools in which the UDL participants were employed. However, they did not participate in any of the UDL initiatives or professional development in which the UDL team members participated. In order to obtain necessary information for these individuals, the researcher retrieved staff lists from each school's website to obtain names, positions, and contact information. Additional information on staff lists and positions was obtained through the Department of Education website. For schools whose information was not accessible via the Internet, PATINS staff contacted schools requesting personnel rosters and contact information. The sample of those faculty members with no participation in UDL consisted of 2,166 participants: 74 administrators, 273 special educators, and 1,819 general educators. Table 2 displays the number of schools at different levels of UDL training, as well as faculty at each school based on level of UDL training.

Table 2

School and Faculty Levels of UDL Training

CT Schools			CIT Schools			Total
34			16			50
	Faculty			Faculty		
CT	CIT	NT	CT	CIT	NT	
194	0	1348	0	93	831	2466

Note. CT = Completed UDL Training; CIT = Currently in UDL Training; NT = No UDL Training

The schools that participated in this study represented various areas across Indiana. Table 3 represents the locale of the schools that were used in this study as reported on the Indiana Department of Education website. The majority of participating schools (60%) were considered urban. Urban classification consists of locales including Large City (population ≥ 250,000), Mid-size City (population < 250,000), and Urban Fringe of Large and Mid-size City (within a metropolitan area of a large city and defined as urban by the Census Bureau). Rural schools comprised 40% of participating schools. Rural classification consists of Large Town (population ≥ 25,000), Small Town (population < 25,000), and Rural (defined as rural by the Census Bureau).

Table 3

Locale for Participating Schools

Type	Number	Percentage
Urban	30	60%
Rural	20	40%

Note. Information obtained from IN Dept. of Education website.

Table 4 displays the free/reduced lunch status as an indicator of socio-economic status of the participating schools. This information was obtained from the Indiana Department of Education website. One-third of participating schools had more than 50%

of their students on free or reduced lunch. Forty-two percent of participating schools had a free/reduced lunch percentage that falls within 26% to 50% of their student population. Twenty-four percent had a free/reduced lunch percentage that falls within 0 to 25% of their student population.

Table 4

Free/Reduced Lunch Status of Participating Schools

Percentage Range of Students on Free/Reduced Lunch	Number of Schools	Percentage of Total
0-25%	12	24%
26-50%	21	42%
51-75%	11	22%
76-100%	6	12%
Total	50	100%

Note. Information obtained from IN Dept. of Education website.

Survey Procedures

Survey research is an appropriate methodology to complete this study as it measures perceptions and behaviors, examines group differences, and tests hypotheses about potential sources of perceptions and behaviors (Weisberg, Krosnick, & Bowen, 1996). Gaining adequate participation in survey research is critical. A minimum of thirty participants is commonly held as the necessary sample size to conduct statistical analysis (Cohen, Manion, & Morrison, 2000). Several steps were taken to increase participation in this study. First, the PATINS Project supplied names of all UDL participants during each of the six years that the grant project had been in operation. The researcher reviewed these names and searched both the state department of education website listing public school employees and their employment location, as well as school/district websites. This allowed for updated contact information and relocations to be identified. In order to locate personnel who could not be found through those means, the PATINS Project contacted UDL team leaders to obtain updated information.

In order to increase participation in this study, the researcher emailed the building administrator at each school in August 2009 prior to the survey being disseminated. The intent of this initial contact was to foster an awareness of the project and to seek permission for survey distribution. Only two principals denied the researcher's request to survey all staff members. The researcher emphasized through this contact that participation in this study would contribute to the knowledge base and practical application of UDL principles, assist other schools and districts in implementing UDL, and contribute to a growing state and national focus on UDL through the PATINS Project and the Center for Applied Special Technology (CAST). The researcher sent a follow-up email to principals at the end of August 2009 to notify them that the surveys would be distributed within two weeks. Upon receipt of this follow-up email from the researcher, some principals sent emails to their staff to notify them that the survey request would soon be coming via email. One high school principal included information about the survey in his weekly staff newsletter.

The study involved an eight-week survey period with four iterations of two-week follow-ups. Initial emails were sent the first week of September 2009. Email listings were updated prior to each subsequent email distribution to ensure that respondents who had completed the survey did not receive additional emails. In mid-September 2009 (two weeks after the initial email), follow-up emails were sent to those individuals who had not yet completed the survey. A third email was sent the first week of October 2009 to those that had not yet participated. Finally, at the end of October 2009 (six weeks from initial contact with potential participants), a final email was sent to solicit participation.

A code was utilized to protect the identity of participants. The code further aided in the email distribution of the survey, and assisted the researcher in determining response rates. Participants were numbered sequentially within their current position. Non-certified positions (custodians, paraprofessionals, and school nurses) were not included in survey dissemination. All participants were assigned a 7-digit code. The first digit of the code identified whether participants had received UDL training or not. The second and third digit identified the school at which participants were employed. The fourth digit identified the position within the school (e.g., administrator, general education teacher, special education teacher). The fifth, sixth, and seventh digits identified the participant's number within that position. For example: 1123002 would equate to a participant who was trained in UDL, from site number 12, and was an administrator who was 2nd out of the total number of administrators from that site.

Instrumentation

This study consisted of mixed methods research that assessed school faculty perceptions using a survey instrument constructed by the researcher. The survey was created based on input from the state coordinator of the PATINS Project. As part of PATINS procedures for participating UDL teams, a survey had been created and was submitted periodically during a school's participation in the grant. Additional information was added to the survey based on review of other technology and UDL survey instruments (Blankenship, 1998; Navarro, 2008; Macomb UDL Survey, n.d.), UDL rubrics and checklists (Abell, 2006), and additional input from state PATINS staff. The survey was disseminated to administrators and teachers within participating schools.

Surveys were distributed electronically via the inQsit system through the Ball State University website. Each survey was coded to ensure confidentiality and only the researcher and the faculty advisor had access to the coding sequences. Each potential respondent received a unique email from the researcher explaining the study. Embedded within the email was a coded web link to the inQsit survey system. Upon being directed to the inQsit system, respondents were presented with an informed consent form and asked to click “I Agree” or “I Decline.” Upon clicking “I Agree” respondents were directed to the online survey. A brief overview and directions were presented, followed by survey questions which utilized a Likert-type scale to assess respondents’ perceptions. The Likert scale is valuable for researchers to make more specific distinctions between the participants, as well as assess a more complex phenomenon (Johnson & Christensen, 2000).

Respondents’ perceptions of addressing diverse needs of students in the general education classrooms were addressed through survey questions aligned on a five-point Likert-type scale. Intervals were placed on a 100 point scale to provide the respondent with additional description of what each interval on the scale represented. By associating each interval with a 100 point scale, the respondents could gain a description of the percentage of agreement with each item and rating. The interval scale included Strongly Disagree (0-25), Disagree (26-50), Agree (51-75), Strongly Agree (76-100), and Do Not Know. “Do Not Know” responses provided descriptive data to highlight areas where respondents’ awareness may be an issue, but were removed prior to statistical analysis.

Data analysis examined means and standard deviations. Differences in respondents' perceptions were analyzed using parametric analysis including the one-way analysis of variance (ANOVA). Non-parametric statistics were used to confirm significance utilizing the Kruskal-Wallis test. When respondents' perceptions were disaggregated further into general education/special education or administrator/teacher, analyses were completed using the non-parametric Kruskal-Wallis test examining mean ranks.

Respondents' perceptions of how instruction was differentiated and how technology was utilized within classroom were addressed through survey questions aligned on a five-point Likert-type scale. Additional clarification was provided to each point on the scale to facilitate clarity of respondents' understanding. This scale was presented to assess frequency of use and was organized as an ordinal scale. The scale consisted of Never (not at all), Sometimes (1-2 times/month), Often (1-2 times/week), Very Often (daily), and Do Not Know. "Do Not Know" responses were removed prior to statistical analysis. Data analysis examined means and standard deviations. Differences in respondents' perceptions were analyzed using the parametric ANOVA analysis, while the non-parametric Kruskal-Wallis was completed to confirm significance. When respondents' perceptions were disaggregated further into general education/special education or administrator/teacher, analyses were completed using the non-parametric Kruskal-Wallis test.

The final section of the survey addressed respondents' perceptions of factors leading to technology integration within classrooms. Additional clarification was provided to each point on the scale by linking the rating to a 100 point scale to facilitate clarity of respondents' understanding. This scale was presented to assess perceived importance of the variables presented. The scale consisted of Not Important (0-25), Sometimes (26-50), Often (51-75), Very Often (76-100), and Do Not Know. “Do Not Know” responses were removed prior to statistical analysis. These variables were designed to identify which variables were perceived as being most important. Means and standard deviations were utilized to analyze respondents’ data. This section also included an open-ended question used for qualitative analysis which allowed respondents to indicate other factors impacting their ability to utilize technology with diverse students.

Jury Panel

The survey instrument was presented to a jury panel in order to ensure its appropriateness. This panel included the Indiana PATINS State Coordinator, PATINS Site Coordinators (n=5), Assistive Technology/UDL Consultants (n=4), a professor specializing in Universal Design for Learning, and the Director of Professional Development and Outreach Services at Center for Applied Special Technology (CAST). Revisions were made to the survey instrument upon receipt of the jury panel feedback to ensure the survey instrument had adequate face and content validity.

Various feedback was obtained from the jury panel upon their review of the survey. A common theme of jury panel feedback from members with a national perspective was that the original survey focused too strongly on technology, and not enough on overall UDL framework and philosophy. In response to these concerns, five questions were added that examined respondents’ perceptions related to overall UDL philosophy with no reference to technology. Integrating technology into classrooms using a UDL framework was a major goal of the PATINS UDL Project, and the researcher was unable to make the survey overly specific to UDL terminology as the majority of respondents had no training in UDL.

Jury panel feedback from those members within the PATINS staff was useful as they understood the focus of the PATINS UDL grants and the context of the study. They provided feedback that led to questions being made more specific, as well as the addition of questions that addressed certain forms of technology based on their work across the state. In addition, some PATINS staff reiterated similar concerns as national reviewers that the survey needed more focus on broader UDL philosophies without reference to technology.

Survey

Survey research is valuable in social science research because of its description of a phenomena, as well as relationships that may be present between these phenomena (Cohen et al., 2000). The survey used in this research was constructed by the researcher with most questions following a Likert-type scale. An open-ended question was also included to allow participants to provide responses that might not have been captured in other questions. Survey questions using the Likert-type scale allowed for quantitative analyses through comparisons of the respondent groups. Targeted questions with ratings were utilized to provide for quantitative analysis, while an open-ended question was included to allow for a qualitative analysis of participant responses (Johnson & Christensen, 2000). The combination of quantitative and qualitative approaches of data analysis combined to function as a meaningful mixed methods analysis that provided valuable information to policy makers, teachers, and administrators. By utilizing a mixed methods analysis, the goal of this research was to seek a “better, more comprehensive understanding of educational phenomena" (Greene, 2005, p. 208). The format of this research sought to capitalize on the value of descriptive research that examines "individuals, groups, institutions, methods, and materials in order to describe, compare, contrast, classify, analyse [*sic*], and interpret the entities and the events that constitute their various fields of inquiry" (Cohen et al., 2000, p. 169).

The survey included two parallel forms, including one for teacher respondents and one for administrator respondents. The core content of the survey questions distributed to teachers and administrators was the same, but was presented in a manner that accounted for their different perspectives. Based on the staffing lists obtained through individual school and DOE websites, the researcher ensured that the survey link distributed via email directed respondents to the correct survey form.

Survey Introduction

Upon indicating their agreement with the informed consent form, respondents were directed to the online survey. The survey began with an introductory section specifying that the survey was intended to obtain information about accommodating diverse learners and how technology was used within classrooms. The introduction also identified in what areas respondents' perceptions would be analyzed, including inclusion of students with disabilities, technology use in classrooms, differentiating instruction, student engagement, and factors that impact technology integration. The introductory section ended with a statement of appreciation for participation in the study.

Section I

The first section of the survey gathered demographic data on respondents, including role (general education teacher, special education teacher, building administrator, district administrator), age, and years of experience in education. Questions in the first section also included whether respondents had received training in the PATINS UDL program. Respondents also indicated whether they had participated in other training in UDL at their school/district, as well as any other training in technology.

Section II

The second section of the survey consisted of a 5 point Likert-type scale with a "Do Not Know" option. This section collected information pertaining to respondents' perceptions of the inclusion of students with disabilities, as well as their views on the impact that accommodations have on all learners. Allowing respondents to select "Do Not Know" allowed for the identification of areas where staff lacks awareness in technology and special education issues. The Likert-type scale on which participants were asked to rate was based on a 100 point scale and included the following: 1=Strongly Disagree (0-25); 2=Disagree (26-50); 3=Agree (51-75); 4=Strongly Agree (76-100); and 5=Do Not Know.

Section III

The third section of the survey consisted of a 5 point Likert-type scale. Participants were asked to address specific ways in which they differentiate instruction within their classrooms or schools. Respondents were also asked with what frequency they utilize specific technology tools. Due to the nature of these questions, the scale consisted of the following points: 1=Never (not at all); 2=Sometimes (1-2 times per month); 3=Often (1-2 times per week); 4=Very Often (daily); and 5=Do Not Know.

Section IV

Section four of the survey gave participants an opportunity to identify factors that impact technology integration within their classrooms/schools. This section utilized a 5-point Likert-type scale that included the following descriptors on a 100 point scale: 1=Not Important (0-25); 2=Somewhat Important (25-50); 3=Important (51-75); 4=Very Important (76-100); and 5=Do Not Know. This section also included one open-ended question that allowed participants to identify additional factors that were not included in the previous questions.

Pilot Testing

In order to ensure that a survey is appropriate in gathering the specified information, it is important to pilot test the instrument (Weisberg et al., 1996). Upon completion of the jury panel review, the survey instrument was pilot tested. The pilot test provided an opportunity to assess factors including survey clarity, comprehensiveness, and accessibility (Rea & Parker, 1992). The survey instrument was pilot tested in one elementary school and one secondary school that had not participated in the UDL project. The survey was presented for pilot testing via the Ball State University online survey system, inQsit, in the same manner in which it was generated for the actual study. The only variations made to the pilot test were the addition of questions allowing participants to provide feedback to the researcher on the clarity of the interview questions, the reasonableness of the amount of time needed to complete the survey, and an open-ended question to allow participants to provide additional feedback to the researcher. Pilot testing generated an adequate sample size to gather feedback on the overall quality, clarity, and reliability of the survey instrument. As a result of the feedback provided by pilot test participants, additional clarification was added to one survey question. Through the completion of the pilot test, the researcher was able to determine that the design feature of the study yielded appropriate and anticipated statistical analysis. The pilot sites and the pilot test data were not used in the dissertation research study.

Participation Rates

The online survey was sent electronically to 2,466 faculty members across the state of Indiana. Table 5 demonstrates participation rates for this study. This study had a participation rate of 28% as 696 individuals completed the survey. Five of those completed surveys (0.2%) were discarded because the respondents failed to respond to the survey question indicating their participation level in the PATINS UDL training. This study generated adequate participation (28%) particularly given the use of electronic survey methodology. When using an electronic survey, it is not uncommon to garner response rates lower than 20% (Andrews, Nonnecke, & Preece, 2003). Of those individuals who were sent the survey, 132 (5.4%) declined participation, while 212 (8.6%) experienced technology problems. Technology problems consisted of emails getting sent back to the researcher or the respondent reporting problems accessing the online survey. Of those surveys that were distributed, 1,426 (57.8%) were considered “No Response”. These individuals did not reply to the email or complete the survey.

Table 5

Overall Response Rates

	n	%
Completed (Valid)	691	28.0
Completed (Not Valid)	5	0.2
Declined	132	5.4
Technology Problems	212	8.6
No Response	1426	57.8
Total	2466	100

Note. Valid surveys indicated respondents' level of UDL training.

Table 6 displays the demographic data for respondents based on their level of UDL training and their categorization as administrators or teachers. Information is disaggregated to display key demographic data for the survey, including school description, age, and years experience in education.

Table 6

Administrator/Teacher Categorization Based on Level of UDL Training

	Currently in UDL Training (CIT)				Completed UDL Training (CT)				No UDL Training (NT)					
	Admin		Teacher		Admin		Teacher		Admin		Teacher		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
School Description														
Elementary	3	12.5	17	22.4	12	52.2	33	35.1	7	30.4	143	31.9	215	31.3
Mid/Jr High	5	20.8	17	22.4	2	8.7	20	21.3	2	8.7	76	17	122	17.7
High School	13	54.2	38	50	1	4.3	25	26.6	12	52.2	206	46	295	42.9
District Level	3	12.5	2	2.6	7	30.4	8	8.5	1	4.3	3	0.7	24	3.5
Other	0	0	2	2.6	1	4.3	8	8.5	1	4.3	20	4.5	32	4.7
Total	24	100	76	100	23	99.9	94	100	23	99.9	448	100.1	688	100
Age														
Under 24	0	0	1	1.3	0	0	0	0	0	0	18	4	19	2.8
25-34	4	16	32	42.7	3	13.6	34	36.2	5	21.7	151	33.6	229	33.3
35-44	8	32	15	20	7	31.8	25	26.6	9	39.1	96	21.4	160	23.3
45-54	6	24	18	24	8	36.4	22	23.4	5	21.7	109	24.3	168	24.4
55 and over	7	28	9	12	4	18.2	13	13.8	4	17.4	75	16.7	112	16.3
Total	25	100	75	100	22	100	94	100	23	99.9	449	100	688	100
Years Experience														
0-5 years	0	0	15	20	1	4.3	9	9.7	0	0	95	21.1	120	17.4
6-10 years	3	12	19	25.3	1	4.3	28	30.1	2	8.7	104	23.1	157	22.8
11-20 years	10	40	20	26.7	6	26.1	32	34.4	13	56.5	121	26.9	202	29.3
20+ years	12	48	21	28	15	65.2	24	25.8	8	34.8	130	28.9	210	30.5
Total	25	100	75	100	23	99.9	93	100	23	100	450	100	689	100

Note. Percent by category is based on valid data responses within each category.

Table 7 displays the demographic data for respondents based on their level of UDL training and their categorization as general education or special education. Information is disaggregated to display key demographic data for the survey, including school description, age, and years experience in education.

Table 7

General Education/Special Education Categorization Based on Level of UDL Training

	Currently in UDL Training				Completed UDL Training				No UDL Training					
	Gen Ed		Sp Ed		Gen Ed		Sp Ed		Gen Ed		Sp Ed		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
School Description														
Elementary	14	17.7	6	28.6	36	42.9	9	27.3	129	32.4	21	28.8	215	31.3
Mid/Jr High	18	22.8	4	19	17	20.2	5	15.2	68	17.1	10	13.7	122	17.7
High School	43	54.4	8	38.1	19	22.6	7	21.2	187	47.0	31	42.5	295	42.9
District Level	3	3.8	2	9.5	9	10.7	6	18.2	3	0.8	1	1.4	24	3.5
Other	1	1.3	1	4.8	3	3.6	6	18.2	11	2.8	10	13.7	32	4.7
Total	79	100	21	100	84	100	33	100.1	398	100.1	73	100.1	688	100
Age														
Under 24	1	1.3	0	0	0	0	0	0	16	4.0	2	2.7	19	2.8
25-34	30	37.5	6	30	29	34.9	8	24.2	134	33.6	22	30.1	229	33.3
35-44	19	23.8	4	20	24	28.9	8	24.2	89	22.3	16	21.9	160	23.3
45-54	20	25	4	20	17	20.5	13	39.4	87	21.8	27	37	168	24.4
55 and over	10	12.5	6	30	13	15.7	4	12.1	73	18.3	6	8.2	112	16.3
Total	80	100.1	20	100	83	100	33	99.9	399	100	73	99.9	688	100
Years Experience														
0-5 years	13	16.5	2	9.5	8	9.6	2	6.1	77	19.3	18	24.7	120	17.4
6-10 years	18	22.8	4	19	20	24.1	9	27.3	92	23	14	19.2	157	22.8
11-20 years	26	32.9	4	19	28	33.7	10	30.3	112	28	22	30.1	202	29.3
20+ years	22	27.8	11	52.4	27	32.5	12	36.4	119	29.8	19	26	210	30.5
Total	79	100	21	99.9	83	99.9	33	100.1	400	100.1	73	100	689	100

Note. Percent by category is based on valid data responses within each category.

Research Design

This study consisted of descriptive research with the intent to provide information on groups of school personnel at varying levels of participation in UDL training and school faculty from the same schools with no participation in UDL training. This study meets Fink's (2003) criteria for a cross-sectional survey in which the researcher gathers descriptive data at one fixed point in time. This study also represents a case-control design (Fink, 2003) in which the researcher sets out to explain about a phenomenon by comparing one group who is involved in the phenomenon and another group who is not.

Dependent variables in this study included faculty views of the inclusion of students with disabilities into the general education classroom, technology use to differentiate instruction, faculty perceptions of student engagement, and factors that positively impact technology integration into the curriculum. The independent variables for analysis consisted of the three levels of participation in the UDL grant initiative in which the respondents were categorized (Completed Training, Currently in Training, No Participation in Training). The independent variables for analyses based on categorization as administrator or teacher and general education or special education consisted of two levels of participation in the UDL grant initiative (UDL Trained and Not UDL Trained).

Data Analysis

The statistical procedures used in this study involved descriptive statistics, including frequency distributions, means, percentages, and standard deviations. Statistical calculations were completed utilizing Statistical Program for the Social Sciences (SPSS 17.0). Analyses were initially completed between three groups – completed UDL training (CT), currently in UDL training (CIT), and no UDL training (NT). Further analyses were conducted on the following respondent groups: 1) administrators who participated in UDL (AdUDL), administrators who did not participate in UDL (AdNoUDL), teachers who participated in UDL (TchUDL), and teachers who did not participate in UDL (TchNoUDL) and 2) general educators who participated in UDL (GenUDL), general educators who did not participate in UDL (GenNoUDL), special educators who participated in UDL (SpUDL), and special educators who did not participate in UDL (SpNoUDL).

Research questions were analyzed with SPSS statistical analysis applying the null hypothesis that there are no differences between faculty members with different levels of UDL training. Research questions one, two, and three were analyzed using descriptive statistics, including frequency, percentages, means, and standard deviations. Levene's test of equal variance was completed to ensure that the assumption of equal variance was met. Exploratory statistical analyses of the larger comparisons of three respondent groups (CT, CIT, and NT) within research questions one, two, and three were completed using one-way analysis of variance (ANOVA) which was reported as an F statistic if there was equal variance between the three groups (Completed Participation, Currently Participating, No Participation) based on Levene's test. If there were unequal variances between the groups based on Levene's test, a Welch Test was performed because of its accounting for unequal variance within the analysis (McDonald, 2009). A cross reference of parametric analyses was completed using the Kruskal-Wallis test. The Kruskal-Wallis test is nonparametric in that it is a distribution-free statistical analysis that makes no assumption about normal distribution of the data. The Kruskal-Wallis test examines differences by mean ranks and generates an H statistic which has approximately a chi-square distribution and is reported as a chi-square statistic ($\chi 2$) (Welkowitz, Cohen, & Ewen, 2006). Post hoc analyses were completed on ANOVA analyses using the Bonferroni test, while the Tamhane test was completed on Welch analyses.

After the three-group comparisons were completed, additional analyses were completed that examined respondents' perceptions based on their categorization as administrators or teachers. In these analyses, CT and CIT respondents were grouped together to represent faculty trained in UDL. Their responses were compared to those with no training in UDL which led to four groups in these analyses – administrators trained in UDL, administrators not trained in UDL, teachers trained in UDL, and teachers not trained in UDL. The Kruskal-Wallis test was used to generate a chi-square statistic for these analyses as one group had fewer than thirty respondents. The non-parametric Kruskal-Wallis test was used for these analyses as it makes no assumptions regarding normal distribution (Welkowitz et al., 2006).

Similar analyses were also completed based on respondents' categorization as general education or special education. In these analyses, CT and CIT respondents were again grouped together to represent faculty trained in UDL. Their responses were compared to those with no training in UDL which led to four groups in these analyses – general educators trained in UDL, general educators not trained in UDL, special educators trained in UDL, and special educators not trained in UDL. Kruskal-Wallis test was used to identify associative differences between respondent groups' mean ranks.

Research question four was analyzed using frequency, means, and standard deviations to identify different factors contributing to technology use in schools. This analysis was intended to provide data that would identify professional development priorities and needs related to technology integration and UDL. Deeper analyses beyond means and standard deviations were not completed as the intent of the research question was not to identify differences between groups, but to identify factors impacting the use of technology integration. Analyses were completed to identify which factors were identified by respondents as having the greatest importance on technology integration. Qualitative analysis was completed on one open-ended survey question related to research question four which allowed respondents to identify additional factors impacting their ability to utilize technology with diverse students. Responses to this question were analyzed and coded by the researcher to establish central themes. Responses within the central themes were then analyzed examining the frequency and percentages of these themes.

CHAPTER FOUR

Results and Discussion

Overview

There were 691 respondents in this study representing a 28% return rate. Descriptive statistics including frequencies, percentages, means, and standard deviations were presented in this study. Initial analyses of respondents' perceptions were based on three groups – those who completed UDL training (CT), those currently in training (CIT), and those with no training in UDL (NT). Analysis of variance (ANOVA) tests were completed to test for statistical significance between groups. It is critical to address three basic assumptions in order to test for significance using ANOVA tests, including the following: 1) normal distribution of the independent variable; 2) independence of subjects; and 3) equal variances of groups (Levene's Test of Homogeneity of Variances) (Marascuilo & Serlin, 1988). The assumption of normal distribution was met using Q-Q plots which identified normal distribution on all variables. The assumption of independence of subjects was met by allowing subjects to complete the survey confidentially via the Internet with a coded link. The assumption of equal variance was met by using Levene's test and identifying variables with unequal variance (significant at $p<.05$ level).

When analyses were completed in which equal variance could not be assumed based on significance of Levene's test, the Welch F test was utilized. The Welch F test was used to analyze differences while accounting for unequal variances when Levene's test was found to be significant (McDonald, 2009). The non-parametric Kruskal-Wallis H test was used to confirm significance found in the parametric analyses. The Kruskal-

Wallis *H* test looks at ranked order and under the null hypothesis is reported as chi-square ($\chi 2$) (Welkowitz et al., 2006). Post hoc analysis was completed on ANOVA analyses using the Bonferroni test, while the Tamhane test was used on Welch analyses in order to better account for unequal variance (Xu, 2005).

Analyses were also completed based on respondents' categorization as administrators or teachers. Administrator/teacher analyses should be considered exploratory in nature as the group of administrators with no training in UDL was not large enough for parametric statistical analysis (n=23). Additional analyses examined differences in perceptions based on categorization as general education or special education. Differences in respondents' group mean ranks were analyzed using the Kruskal-Wallis test. The Kruskal-Wallis test was used because it does not make any assumptions on the normality of data (McDonald, 2009).

The data was collected and organized to address four research questions. These questions were created in order to address the perceptions of general and special education teachers and administrators regarding the impact of training and support in Universal Design for Learning for all students, including those with exceptional learning needs (ENL). The analysis of study data was done using the Statistical Program for the Social Sciences 17.0 (SPSS) (2008).

Survey questions which yielded these analyses were based on a five-point Likert scale with descriptors that varied based on question content. The lowest point on the scale (1) was classified as strongly disagree, never (not at all), or not important depending on the question content. The second point on the scale (2) was classified as disagree, sometimes (1-2 times/month), or somewhat important. The third point on the scale (3) was classified as agree, often (1-2 times/week), or important. The highest point on the scale (4) was classified as strongly agree, very often (daily), or very important. The fifth point on the scale (5) was a “Do not know” option. “Do not know” responses were initially collected to provide an overall perspective of areas in which lack of knowledge may be an area of concern. “Do not know” responses were then removed to provide a more detailed analysis of those respondents that did have an awareness and knowledge of the issues being analyzed.

Research Question 1

Are there differences in faculty perceptions of the inclusion of students with disabilities in general education classrooms between those who participated in UDL professional development and those who have not?

Table 8 displays respondents’ perceptions of inclusion based on the level of UDL training among three groups—those who have completed training (CT), those currently in training (CIT), and those who have not participated in UDL training (NT). When examining faculty perceptions that students with disabilities were adequately included into general education classrooms, twelve respondents (1.7%) reported “Do Not Know” or did not answer the question. Of the remaining valid responses (n=679), all respondents had high levels of agreement (respondent means ranged between 3.44 and 3.48). Equal variance could be assured as Levene’s test was not statistically significant. ANOVA analysis did not find any statistically significant differences (F = 0.20) between respondent groups. Kruskal-Wallis non-parametric test was used to cross-reference the ANOVA analysis. Kruskal-Wallis analysis confirmed that there were no significant differences in mean ranks ($\chi 2$ = 0.89, df 2, p=.64).

Respondents were asked to indicate their perceptions that students with disabilities who are included in general education classrooms are making adequate progress toward the grade level standards in the curriculum being taught. Sixty-one respondents (8.8%) indicated “Do Not Know” and four respondents (.6%) did not answer the question. These responses were removed prior to ensure analysis of valid responses (n=626). Equal variance could be assured as Levene’s Test was not statistically significant. ANOVA analysis found no statistically significant difference (F = 0.73) between the respondent groups’ means (CT=2.92; CIT=2.88; NT=2.83). The mean responses for all groups fell within the upper range of the “Disagree” categorization. Kruskal-Wallis analysis confirmed that there were no significant differences in mean ranks ($\chi2$ = 1.59, df 2, p=.45).

Table 8 displays respondents’ perceptions that the primary responsibility for accommodating classroom activities for students with disabilities in the general education classroom lies with the special education teacher. Sixteen respondents (2.3%) indicated “Do Not Know” or did not answer the question. The remaining responses were considered valid for statistical analysis (n=675). Equal variance could be assured as Levene’s test was not significant (p>.05). ANOVA analysis found a significant difference in respondents’ perceptions that special educators assume primary responsibility for accommodations for students with disabilities that are included in general education classrooms (F = 6.95 significant at the p<.001 level). The results indicate that those faculty members who are currently participating in UDL training had higher level of disagreement (M = 2.06) compared to CT and NT respondents (M = 2.46 and 2.23 respectively) that special educators have primary responsibility for accommodating students with special needs. Post hoc analysis using the Bonferroni test found a significant difference between the means of CIT (M = 2.06) and CT respondents (M = 2.46) (significant at the $p<.001$ level). A significant difference was also found (significant at the $p<.05$ level) between CT (M = 2.46) and NT (M = 2.23) respondents. Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi2 = 14.09$, df 2, $p<.001$) with CIT respondents indicating higher level of disagreement than CT and NT respondents.

Table 8 displays respondents' perceptions that accommodations designed for students with disabilities usually create increased opportunities for all learners. Thirty respondents (4.3%) indicated "Do Not Know" or did not answer the question. The remaining responses were considered valid for statistical analysis (n=661). Equal variance could be assured as Levene's test was not significant ($p>.05$). ANOVA analysis found a significant difference between respondent groups ($F = 25.56$ significant at the $p=.001$ level). Solid agreement was found for both groups of respondents who have participated in UDL training (CT = 3.46; CIT = 3.44) that were significantly higher than those respondents groups' means with no UDL training (NT = 2.99). Post hoc analysis using the Bonferroni test found a significant difference (significant at the $p=.001$ level) between both respondent groups with UDL participation (CT = 3.46; CIT = 3.44) respondents) and NT respondents with no training in UDL (M = 2.99). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi2 = 49.94$, df 2, $p<.001$). Based on mean ranks, CIT and CT respondents indicated a stronger level of agreement that accommodations designed for students with disabilities usually created increased opportunities for all learners.

Table 8

Perceptions of the Inclusion of Students with Disabilities Based on Level of UDL Training

	UDL - Completed			UDL - Current			No UDL				
Question	N	M	SD	N	M	SD	N	M	SD	df	*F*
Students with disabilities in my school are adequately included into general education classrooms.	115	3.44	0.69	101	3.44	0.74	463	3.48	0.73	2	0.20
Students with disabilities who are included in general education classrooms are making adequate progress toward the grade-level standards in the curriculum being taught.	108	2.92	0.66	96	2.88	0.64	422	2.83	0.70	2	0.73
The primary responsibility for accommodating classroom activities for students with disabilities included in general education classrooms lies with special education teachers.	115	2.46	0.83	101	2.06	0.83	459	2.23	0.79	2	6.95***
Accommodations designed for students with disabilities usually create increased opportunities for all learners.	110	3.46	0.66	97	3.44	0.69	454	2.99	0.82	2	25.56***

Note. *p <.05, **p <.01, ***p<. 001

Further analysis was completed on those variables found to be statistically significant. The respondent groups that were initially examined based on CT, CIT, and NT categorization were analyzed based on respondents' categorization as general education or special education and administrator or teacher. Analyses were completed that compared general educators and special educators that received UDL training (GenUDL and SpUDL), as well as their colleagues that had not received UDL training (GenNoUDL and SpNoUDL). Kruskal-Wallis analyses were used to identify differences in respondents' mean ranks for several reasons. First, Kruskal-Wallis makes no assumptions regarding normality of data. Second, for analyses regarding administrators and teachers, not all respondent groups contained 30 participants to allow for valid parametric analyses. Finally, some variables were assessed on an ordinal scale which was appropriate for analysis based on mean ranks. These deeper analyses based on respondents' specific categorizations allowed for a more comprehensive study examining differences in respondents' perceptions based on their role.

Table 9 outlines the level of agreement that general educators and special educators have in response to special education teachers having primary responsibility for accommodating classroom activities for students with disabilities. General educators who participated in UDL training indicated the lowest level of agreement of any group which leaned toward "Disagree" (M = 2.15). Special educators who participated in UDL training indicated the highest level of agreement of all groups which leaned toward the "Agree" category (M = 2.64). Table 9 displays the results of the Kruskal-Wallis test which was completed to identify differences in mean ranks. Analysis of mean ranks confirmed that general educators trained in UDL indicated the lowest level of agreement, while special educators trained in UDL indicated the highest level of agreement. Comparisons between respondent groups' mean ranks found a statistically significant difference ($\chi 2 = 15.89$, df 3, $p<.001$).

Table 9

General Education/Special Education Perceptions that Responsibility for Providing Accommodations to Students with Disabilities Lies with Special Education Teachers

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	163	2.15	0.80	317.70		
Sp Ed (UDL)	53	2.64	0.92	420.08	3	15.89***
Gen Ed (no UDL)	387	2.21	0.78	330.23		
Sp Ed (no UDL)	72	2.36	0.83	365.28		
Total	675	2.24	0.81			

Note. *p <.05, **p <.01, ***p<. 001

Table 10 outlines the level of agreement that administrators and teachers have in response to special educators having primary responsibility for accommodating classroom activities for students with disabilities. All respondents tended toward "Disagree" with administrators who participated in UDL training having the lowest level of agreement (M = 2.10). Teachers who participated in UDL training had the highest level of agreement of all groups (M = 2.32). Administrators and teachers with no training in UDL had the same level of agreement (M = 2.23). Kruskal-Wallis test found no significant difference between respondent groups' mean ranks ($\chi2$ = 1.96, df 3).

Table 10

Administrator/Teacher Perceptions that Responsibility for Providing Accommodations to Students with Disabilities Lies with Special Education Teachers

Respondents	N	Mean	Std. Dev.	Std. Error	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	2.10	0.81	0.12	313.86		
Teacher (UDL)	168	2.32	0.86	0.07	351.09	3	1.96
Admin (no UDL)	23	2.23	0.79	0.04	346.59		
Teacher (no UDL)	436	2.23	0.79	0.04	335.16		
Total	675	2.24	0.81	0.03			

Note. *p <.05, **p <.01, ***p<. 001

Analysis was also completed which examined general educators and special educators' perceptions that accommodations designed for students with disabilities usually created increased opportunities for all learners. Results from this analysis are depicted in Table 11. Special educators trained in UDL indicated the highest level of agreement (M = 3.62) which tended toward "Strongly Agree." Other respondent groups tended toward the "Agree" category (SpNoUDL=3.45; GenUDL=3.40) with general educators with no training in UDL indicating the weakest level of agreement (M =2.90). Kruskal-Wallis analysis indicated that there was a significant difference in mean ranks with special educators trained in UDL more solidly agreeing that accommodations create increased opportunities for all learners ($\chi 2 = 81.46$, df 3, $p<.001$).

Table 11

General Education/Special Education Perceptions that Accommodations Designed for Students with Disabilities Create Increased Opportunities for All Students

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Mean Rank	df	χ^2
Gen Ed (UDL)	155	3.40	0.71	390.94		
Sp Ed (UDL)	52	3.62	0.53	439.86	3	81.46***
Gen Ed (no UDL)	383	2.90	0.81	278.90		
Sp Ed (no UDL)	71	3.45	0.67	401.49		
Total	661	3.13	0.80			

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 12 presents analysis of respondents' level of agreement that accommodations designed for students with disabilities usually create increased opportunities for all learners based on categorization as administrators or teachers. Analysis was completed that compared administrators and teachers that received UDL training (AdUDL and TchUDL), as well as their colleagues that had not received UDL training (AdNoUDL and TchNoUDL). Respondent groups' means were generally within an "Agree" range (TchUDL=3.40; AdNoUDL=3.30; TchNoUDL=2.97) with administrators trained in UDL tending toward the "Strongly Agree" category (AdUDL=3.64). The non-parametric Kruskal-Wallis test was completed and found administrators trained in UDL had the highest level of agreement supported by mean ranks, while teachers with no UDL training had the weakest level of agreement. Kruskal-Wallis analysis found a statistically significant difference between respondent groups' mean ranks ($\chi 2$ = 57.27, df 3, p<.001).

Table 12

Administrator/Teacher Perceptions that Accommodations Designed for Students with Disabilities Create Increased Opportunities for All Students

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	45	3.64	0.53	447.76		
Teacher (UDL)	162	3.40	0.70	390.86	3	57.27***
Admin (no UDL)	23	3.30	0.70	367.72		
Teacher (no UDL)	431	2.97	0.82	294.35		
Total	661	3.13	0.80			

Note. *p <.05, **p <.01, ***p<. 001

Summary

Results of these analyses suggest that training in UDL impacted faculty perceptions about the inclusion of student with disabilities. Significant differences were found between CT, CIT, and NT respondents in the perception that the primary responsibility for accommodating classroom activities for students with disabilities lies with the special education teacher. Specifically, significant differences were found between both respondent groups trained in UDL, as well as those who had completed

UDL training and those with no UDL training. A significant difference was also found in perceptions that accommodations designed for students with disabilities usually create increased opportunities for all learners. Specifically, significant differences were found between both respondent groups trained in UDL and those with no training in UDL.

Significant differences were also found between general educators and special educators in special education teachers having primary responsibility for providing accommodations for students with disabilities. Both respondent groups of general educators reported the lowest level of agreement. Analysis of general educators and special educators' perceptions that accommodations usually create increased opportunities for all students found significant differences with general educators with no training in UDL reporting the lowest level of agreement. Analysis of administrators and teachers' perceptions found a significant difference when examining perceptions that accommodations create increased opportunities for all students with higher agreement being reported from respondent groups trained in UDL.

Research Question 2

Are there differences in how technology is used in the classrooms of teachers who participated in professional development in UDL and those who have not?

In order to analyze the use of technology in classrooms between three groups, analysis of variances (ANOVA) tests were completed. If the assumption of equal variance was not met as demonstrated through Levene's test, the Welch test was used in the analysis. In order to find specific differences between groups, post hoc analyses were completed using either the Bonferroni test for survey items with equal variance or the Tamhane test when unequal variance was reported. To confirm these results, the non-parametric Kruskal-Wallis test was completed. Survey questions were presented in an ordinal progression on a Likert-type scale to quantify respondents' frequency of use. The Likert-type scale provided a format through which respondents' perceptions could be analyzed utilizing means and standard deviations. Due to the ordinal progression of this scale, the Kruskal-Wallis test was used to confirm ANOVA analyses. Additional analyses of respondents' perceptions based on categorization as general education or special education and administrator or teacher were completed using the non-parametric Kruskal-Wallis test.

Overall Perceptions of UDL Philosophies and Technology Integration

Table 13 displays respondents' perceptions of key UDL philosophies, as well as the use of technology within classrooms or schools based on level of UDL training among three groups—those who have completed training (CT), those currently in training (CIT), and those who have not participated in UDL training (NT). Table 12 displays respondents' perceptions that material is presented to students through multiple means to allow for more flexibility in instruction. Nineteen respondents (2.7%) indicated "Do Not Know" or did not answer the question. Equal variance could be assured as Levene's test was not statistically significant. All respondent groups reported material is presented through multiple means within the "Often (1-2 times/week)" category. Respondents with no UDL training reported higher frequency (NT=3.47) than other respondent groups (CT=3.39; CIT=3.37). ANOVA analysis found no significant difference between respondent groups (F=1.35). Kruskal-Wallis analysis confirmed that there was no significant difference in mean ranks ($\chi 2$ = 2.46, df 2). Study respondents agreed that

“Often (1-2 times/week)” material is presented to students through multiple means to allow for more flexibility in instruction.

Table 13 displays respondents’ perceptions of the frequency with which technology is used to provide students with more choice and flexibility in completing assignments. Nineteen respondents (2.7%) indicated “Do Not Know” or did not answer the question. Equal variance could be assured as Levene’s test was not statistically significant. Faculty currently participating in UDL training indicated more frequency of technology usage for that purpose (M = 3.14) than those who have completed training (M = 3.08). However, both groups’ responses were within the “Often (1-2 times/week)” category. Those respondents with no UDL training indicated the least frequency though still tending toward “Often (1-2 times/week)” (M = 2.92). ANOVA analysis found a statistically significant difference ($F = 3.59$ significant at the $p<.05$ level) between respondents’ perceptions. Post hoc analysis using the Bonferroni test did not yield additional significance between groups. Kruskal-Wallis analysis confirmed that there were significant differences in respondents’ mean ranks ($\chi 2 = 6.07$, df 2, $p<.05$).

Table 13 displays respondents’ perceptions that technology is used to present material in ways that support all students learning. Seventeen respondents (2.5%) indicated “Do Not Know” or did not answer the question. Equal variance could be assured as Levene’s test was not statistically significant. All groups reported frequency of use within the “Often (1-2 times/week)” category with CT respondents indicating a higher level of frequency (M = 3.44) than CIT respondents (M = 3.31). Respondents with no training reported the lowest level of frequency though still within the “Often (1-2 times/week)” category (M = 3.16). ANOVA analysis found a significant difference between respondent groups (*F*=5.64 significant at the *p*<.01 level). Post hoc analysis using the Bonferroni test found a significant difference at the *p*<.01 level between those who have completed UDL training (M = 3.44) and those with no UDL training (M = 3.16). Kruskal-Wallis analysis confirmed that there was a significant difference in respondent groups' mean ranks ($\chi 2$ = 11.84, df 2, *p*<.01).

Table 13 displays respondent groups' perceptions that students are given choices in how they are assessed and demonstrate their learning. Twenty-five respondents (3.6%) indicated "Do Not Know" or did not answer the question. Equal variance could be assured as Levene's test was not statistically significant. Mean responses for all respondent groups fell within the "Sometimes (1-2 times/month)" category (CT=2.49; CIT=2.51; NP=2.34) with no significant difference being found between groups (*F*=2.75). Kruskal-Wallis analysis confirmed that there was no significant difference in mean ranks ($\chi 2$ = 5.76, df 2). No differences were reported in perception ratings of frequency with which students are given choices in how they are assessed and demonstrate their learning between groups.

Table 13

Perceptions of Differentiation in Classrooms Based on Level of Participation in UDL Training

	UDL - Completed			UDL - Current			No UDL				
Question	N	M	SD	N	M	SD	N	M	SD	df	*F*
I/Teachers in my school present material to students through multiple means to allow for more flexibility in instruction.	107	3.39	0.67	101	3.37	0.66	464	3.47	0.62	2	1.35
I/teachers in my school utilize technology to provide students with more choice and flexibility in completing assignments.	108	3.08	0.81	101	3.14	0.81	463	2.92	0.91	2	3.59*
I/teachers in my school utilize technology to present material in ways that support all students learning.	109	3.44	0.75	100	3.31	0.80	465	3.16	0.84	2	5.64**
Students in my class/school are given choices in how they are assessed and demonstrate their learning.	106	2.49	0.75	100	2.51	0.77	460	2.34	0.83	2	2.75

Note. $*p<.05$, $**p<.01$, $***p<.001$

Table 14 displays analysis of additional variables which examined the use of technology to accommodate diverse learners. However, each of these variables were found to have unequal variances based on the significance of Levene's test ($p<.05$). In order to account for unequal variance, the Welch test was completed for statistical analysis.

Respondents indicated the frequency with which students were presented with choices in how they receive core instruction. Twenty-seven respondents (3.9%) indicated "Do Not Know" or did not answer the question. Levene's test was statistically significant at the $p<.001$ level. Mean responses for all respondent groups fell within the "Sometimes (1-2 times/month)" category (CT=2.67; CIT=2.74: NT=2.60) and no significant difference was found between groups (Welch F = 1.54, df1 2, df2 200). Kruskal-Wallis analysis confirmed that there was no significant difference in mean ranks ($\chi 2$ = 3.03, df 2).

Table 14 displays the results of analyses examining the frequency with which students are presented with opportunities to express what they have learned using technology. Twenty respondents (2.9%) indicated "Do Not Know" or did not answer the question. Levene's test was statistically significant at the p<.05 level. Both respondent groups trained in UDL reported frequency that tended toward "Often (1-2 times/week)" (CIT = 2.83; CT=2.76), while respondents with no UDL training reported frequency within the "Sometimes (1-2 times/month)" category (M = 2.51). Results of the Welch test found a significant difference between groups (Welch F = 8.73, df1 2, df2 198, p<.001). Post hoc analysis using the Tamhane test found a significant difference (significant at the p<.001 level) between CIT and NT respondents (M = 2.83 and 2.51 respectively), while the difference between CT and NT respondents was significant at the p< .05 level (M = 2.76 and 2.51 respectively). Kruskal-Wallis analysis confirmed a significant difference in respondent groups' mean ranks ($\chi 2$ = 15.52, df 2, p<.001). Both respondent groups trained in UDL reporting stronger frequency supported by mean ranks in how often they present students with opportunities to express what they have learned using technology.

Table 14 displays respondent groups' perceptions on the frequency that technology is used to provide ongoing assessments of student progress. Nineteen respondents (2.7%) indicated "Do Not Know" or did not answer the question. Levene's test was statistically significant at the p<.05 level. All respondent groups indicated frequency that tended towards "Often (1-2 times/week) (CT=2.73; CIT=2.78; NT=2.73).

Welch analysis found no significant difference between groups (Welch *F* = 0.13, df1 2, df2 202). Kruskal-Wallis analysis confirmed that there was no significant difference in mean ranks ($\chi 2$ = 0.28, df 2).

Table 14

Perceptions of Differentiation in Classrooms Based on Level of Participation in UDL Training

	UDL - Completed			UDL - Current			No UDL					
Question	N	M	SD	N	M	SD	N	M	SD	df1	df2	Welch *F*
Students in my class/school are presented with choices in how they receive core instruction.	106	2.67	0.76	99	2.74	0.71	459	2.60	0.85	2	199.69	1.54
Students in my class/school are presented with opportunities to express what they have learned using technology.	108	2.76	0.81	100	2.83	0.80	463	2.51	0.89	2	198.45	8.73***
I/teachers in my school utilize technology to provide ongoing assessments of student progress.	108	2.73	0.77	101	2.78	0.90	463	2.73	0.94	2	201.82	0.13

Note. *p <.05, **p <.01, ***p<. 001

Table 15 displays general educator and special educator perceptions of technology use to provide more choice and flexibility in completing assignments. Both respondent groups trained in UDL responded with higher levels of frequency (GenUDL=3.09; SpUDL=3.19) than those with no training in UDL (GenNoUDL=2.90; SpNoUDL=3.00). Results of the Kruskal-Wallis analysis indicate no significant difference between groups ($\chi 2$ = 7.17, df 3). Survey results indicate no significant difference in the frequency of technology use to provide more choice and flexibility in assignments between respondents considered general education or those considered special education.

Table 15

General Education/Special Education Perceptions of Technology Use to Provide More Choice and Flexibility in Assignments

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Mean Rank	df	χ^2
Gen Ed (UDL)	161	3.09	0.81	356.51		
Sp Ed (UDL)	48	3.19	0.82	381.08	3	7.17
Gen Ed (no UDL)	393	2.90	0.92	322.10		
Sp Ed (no UDL)	70	3.00	0.88	340.73		
Total	672	2.98	0.89			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 16 describes administrator and teacher perceptions of technology use to provide more choice and flexibility in completing assignments. Both groups of administrator respondents reported frequency of technology use for the purpose of providing more choice and flexibility in assignments within the “Often (1-2 times/week)” category (UDL=3.06; NoUDL = 3.18). Teacher respondents trained in UDL were also within this category (M = 3.12), while teacher respondents with no UDL training tended toward the “Often (1-2 times/month)” category (M = 2.90). Kruskal-Wallis non-parametric test was completed and indicate a significant difference between groups ($\chi2$ = 8.06, df 3, p<.05). Teachers with no UDL training indicated the lowest frequency of use compared to other respondent groups as supported by mean ranks.

Table 16

Administrator/Teacher Perceptions of Technology Use to Provide More Choice and Flexibility in Assignments

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	3.06	0.73	347.67		
Teacher (UDL)	161	3.12	0.83	366.48	3	8.06*
Admin (no UDL)	22	3.18	0.80	375.77		
Teacher (no UDL)	441	2.90	0.92	322.38		
Total	672	2.98	0.89			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 17 summarizes respondents' perceptions of technology use to present material in ways that support all students learning based on categorization as general education or special education. All respondent groups reported frequency within the "Often (1-2 times/week)" category with general educators trained in UDL responding with the highest frequency (M = 3.43) of any group (SpUDL = 3.19; GenNoUDL = 3.18; SpNoUDL = 3.09). Results of the Kruskal-Wallis test indicate a significant difference between respondent groups' mean ranks ($\chi 2 = 14.47$, df 3, $p<.01$ level). General educators trained in UDL indicated the highest level of frequency supported by mean ranks in their technology use to present materials in ways that support all students learning.

Table 17

General Education/Special Education Perceptions that Technology Is Used to Present Material in Ways That Support All Students Learning

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Mean Rank	df	χ^2
Gen Ed (UDL)	161	3.43	0.73	382.49		
Sp Ed (UDL)	48	3.19	0.89	332.24	3	14.47**
Gen Ed (no UDL)	395	3.18	0.84	326.34		
Sp Ed (no UDL)	70	3.09	0.79	300.64		
Total	674	3.23	0.82			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 18 displays administrator and teacher perceptions of technology use to present material in ways that support all students learning. All respondent groups' reported frequency within the "Often (1-2 times/week)" category (respondent means ranged from 3.16 to 3.42). Teachers trained in UDL reported the highest frequency, while teachers with no UDL training reported the weakest frequency. Kruskal-Wallis analysis was completed because of the small size of the administrator group and found a significant difference between groups ($\chi 2 = 13.43$, df 3, $p<.01$). Mean ranks supported that teachers trained in UDL indicated the strongest frequency of technology use to present material in ways that support all students learning.

Table 18

Administrator/Teacher Perceptions that Technology Is Used to Present Material in Ways that Support All Students Learning

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	3.23	0.78	333.13	3	13.43**
Teacher (UDL)	161	3.42	0.77	382.22		
Admin (no UDL)	23	3.26	0.81	342.50		
Teacher (no UDL)	442	3.16	0.84	321.42		
Total	674	3.23	0.82			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 19 summarizes the frequency of technology use for students to express what they have learned based on respondents' categorization as general or special educators. Three respondents' group means fell within the "Often (1-2 times/week)" category with faculty trained in UDL indicating a higher frequency (SpUDL = 2.91; GenUDL = 2.76) than respondents with no training in UDL (SpNoUDL = 2.71). General educators with no UDL training reported the lowest frequency which tended toward "Sometimes (1-2 times/month)" (M = 2.47). The Kruskal-Wallis test identified a significant difference between respondent groups' mean ranks ($\chi 2$ = 20.87, df 3, p<.001). Both respondent groups trained in UDL indicated the highest level of frequency supported by mean ranks in their technology use for students to express what they have learned.

Table 19

General Education/Special Education Perceptions of Technology Use for Student Expression of What They Have Learned

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	161	2.76	0.79	369.49		
Sp Ed (UDL)	47	2.91	0.86	403.47	3	20.87***
Gen Ed (no UDL)	393	2.47	0.90	310.00		
Sp Ed (no UDL)	70	2.71	0.84	359.66		
Total	671	2.59	0.88			

Note. *p <.05, **p <.01, ***p<. 001

Table 20 displays respondents' perceptions that students are presented with opportunities to express what they have learned using technology based on their categorization as administrators or teachers. Both administrator respondent groups, as well as teachers trained in UDL had mean responses in or tending toward the "Often (1-2 times/week)" category (AdNoUDL = 3.00; AdUDL = 2.74; TchUDL = 2.81). Teachers with no UDL training reported the lowest frequency which tended toward the "Sometimes (1-2 times/month)" category (M = 2.48). Kruskal-Wallis analysis found a significant difference between respondent groups' mean ranks ($\chi2$ = 23.80, df 3, p<.001). Administrators with no UDL training reported the highest level of frequency, while teachers with no UDL training reported the lowest level of frequency supported by mean ranks.

Table 20

Administrator/Teacher Perceptions of Technology Use for Student Expression of What They Have Learned

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	2.74	0.74	369.27		
Teacher (UDL)	161	2.81	0.83	379.47	3	23.80***
Admin (no UDL)	22	3.00	0.62	428.18		
Teacher (no UDL)	441	2.48	0.90	311.99		
Total	671	2.59	0.88			

Note. *p <.05, **p <.01, ***p<. 001

Summary

ANOVA analyses identified differences between faculty who are currently participating in UDL training, those who have completed training, and those with no training. Significant differences were found in the use of technology to provide students with more choice and flexibility in completing assignments with both respondent groups trained in UDL reporting higher frequency than those with no UDL training. A significant difference was also found in the use of technology to present material in ways that support all students learning with both respondent groups trained in UDL reporting higher frequency than those with no UDL training. Upon deeper examination of respondents' perceptions based on categorization as general education or special education, significant differences were found in the frequency with which technology was used to present material in ways that support all students learning and for students to express what they have learned. Based on respondents' categorization as administrator or teacher, significant differences were found in the frequency with which technology was used to provide more choice and flexibility in assignments, to present material in ways that support all students learning, and for students to express what they have learned.

Perceptions of Specific Technology Applications Within Classrooms

Table 21 displays various types of technology that can be utilized within schools. Respondents were asked to indicate the frequency with which they utilized these forms of technology within their instruction. When examining the frequency with which technology is used for research, 17 respondents (2.4%) indicated “Do Not Know” or did not answer the question. Equal variance could be assured as Levene’s test was not statistically significant. Respondents currently in UDL training indicated the greatest frequency of use which tended toward the “Often (1-2 times/week)” category (M = 2.56). Respondents who had completed training reported frequency within the “Sometimes” category (M = 2.33). Both respondent groups trained in UDL had indicated higher mean responses in their frequency of use than their colleagues with no UDL training (M = 2.16). A significant difference was found between groups using the ANOVA test (F = 10.95 significant at the p<.001 level). Post hoc analysis using the Bonferroni test found a significant difference at the p<.001 level between those currently in UDL training (M = 2.56) and those with no participation in training (M = 2.16). This level of significance was affirmed using the non-parametric Kruskal-Wallis test (χ2 = 23.76, df 2, p<.001).

Respondents also indicated their use of technology in the form of software programs to learn new skills. Twenty-seven respondents (3.9%) reported “Do Not Know” or did not answer the question. Equal variance could be assured as Levene’s test was not statistically significant. CT respondents had mean responses tending toward the “Often (1-2 times/week)” category (CT = 2.50), while CIT and NT respondents had mean responses within the “Sometimes (1-2 times/month)” category (M = 2.37 and 2.08 respectively). The ANOVA test found a significant difference between groups (F = 12.59 significant at the p<.001 level). Post hoc analysis using the Bonferroni test found a significant difference (significant at the p<.01 level) between CIT and NT respondents (M = 2.37 and 2.08 respectively), as well as a significant difference (significant at the p<.001 level) between CT and NT respondents (M = 2.50 and 2.08 respectively). This difference was affirmed by the Kruskal-Wallis non-parametric test ($\chi 2$ = 26.59, df 2, p<.001).

When examining the frequency of technology use in the form of software to reinforce concepts previously learned, 22 respondents (3.2%) indicated “Do Not Know” or did not answer the question. CT respondents indicated more frequent use tending toward the “Often” category (M = 2.63). CIT and NT respondents reported frequency within the “Sometimes” category (M = 2.47 and 2.20 respectively). Equal variance could be assured as Levene’s test was not statistically significant. The ANOVA test found a significant difference between respondent groups (F = 11.68 significant at the p<.001 level). Post hoc analysis using the Bonferroni test found a significant difference (significant at the p<.05 level) between CIT and NT respondents (M = 2.47 and 2.20 respectively). A significant difference (significant at the p<.001 level) was also found between CT and NT respondents (M = 2.63 and 2.20 respectively). This significance was confirmed through the use of the Kruskal-Wallis non-parametric test ($\chi 2$ = 23.06, df 2, p<.001).

Table 21 summarizes the frequency with which respondents report utilizing technology in the form of assessments/tests online. Thirteen respondents (1.9%) reported

"Do Not Know" or did not answer the question. Equal variance was assured as Levene's test was not statistically significant. Both respondent groups trained in UDL indicated similar frequency of use within the "Sometimes" category (CT = 2.09; CIT = 2.07), while those with no training in UDL reported a lower frequency of use that tended toward "Sometimes" (M = 1.82). The ANOVA test found a significant difference ($F = 7.55$ significant at the $p<.001$ level) between groups in the use of assessments/tests online. Post hoc analysis using the Bonferroni test found significant differences (significant at the $p<.05$ level) between both those currently participating and those with no participation (M = 2.07 and 1.82 respectively), as well as those who have completed participation and those with no participation (M = 2.09 and 1.82 respectively; significant at the $p<.001$ level). Kruskal-Wallis analysis confirmed this significance ($\chi2 = 18.00$, df 2, $p<.001$).

Respondents indicated their frequency of technology use for homework online. Twenty-seven respondents (3.9%) reported "Do Not Know" or did not answer the question. Equal variance was assured as Levene's test was not statistically significant. Respondents who have completed UDL training and those with no UDL training reported similar frequency that leaned toward "Sometimes (1-2 times/month)" (M = 1.69 and 1.61 respectively). Those respondents currently in UDL training reported more frequency in technology use for homework online (M = 1.90). The ANOVA test found a significant difference between groups ($F = 3.87$ significant at the $p<.05$ level). Bonferroni post hoc analysis revealed a significant difference (significant at the $p<.05$ level) in comparing those currently participating in the UDL training and those with no participation (M =

1.90 and 1.61 respectively). Kruskal-Wallis analysis confirmed this significance in respondent groups' mean ranks ($\chi 2 = 7.9$, df 2, $p<.05$).

Table 21 highlights other areas where differences exist between groups in terms of technology use. When examining the frequency with which technology is used in the form of multi-media presentations, 19 respondents (2.8%) reported "Do Not Know" or did not answer the question. CIT respondents' group means tended toward the "Often (1-2 times/week)" category (M = 2.70), while other respondent groups' means fell within the "Sometimes (1-2 times/month)" category (CT = 2.34; NT = 2.24). Equal variance could be assured as Levene's test was not statistically significant. The ANOVA test found a significant difference between groups ($F = 10.85$ significant at the $p<.001$ level). Post hoc analysis using the Bonferroni test found a significant difference between CIT and NT respondents (M = 2.70 and 2.24 respectively significant at the $p<.001$ level). A significant difference was also found between CIT and CT respondents (M = 2.70 and 2.34 respectively; significant at the $p<.01$ level). Kruskal-Wallis non-parametric analysis confirmed this significance ($\chi 2 = 20.89$, df 2, $p<.001$).

Respondents also reported the frequency with which they use technology in the form of communications with other students/teachers through email, blogs, or podcasts. Eighteen respondents (2.6%) reported "Do Not Know" or did not answer the question. The mean group responses were within the "Sometimes (1-2 times/month)" category (CT = 2.21; CIT = 2.31; NT = 2.07). Equal variance could be assured as Levene's test was not statistically significant. ANOVA analysis found no significant difference between groups ($F = 2.09$). Kruskal-Wallis analysis confirmed that there were no significant differences in mean ranks ($\chi 2 = 4.95$, df 2).

When looking at the frequency with which technology is used for organization, 18 respondents (2.6%) reported "Do Not Know" or did not answer the question. CT respondents reported frequency of use within the "Sometimes (1-2 times/month)" category (CT = 2.40), while CIT respondents reported frequency that tended toward the "Often (1-2 times/week)" category (M = 2.51). NT respondents also reported frequency that fell within the "Sometimes" range (M = 2.02). Equal variance could be assured as Levene's test was not statistically significant. ANOVA analysis found a significant difference between groups (F = 17.35 significant at the p<.001 level). Post hoc analysis using the Bonferroni test found that significant differences exist (significant at the p<.001 level) between both CIT and NT respondents (M = 2.51 and 2.02 respectively), as well as CT and NT respondents (M = 2.40 and 2.02 respectively). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi 2$ = 38.53, df 2, p<.001).

Respondents were also asked to report on the frequency of technology use for interactive presentation purposes, such as Smart Boards. Nineteen respondents (2.7%) reported "Do Not Know" or did not answer the question. Equal variance could be assured as Levene's test was not statistically significant. Respondents that have participated in UDL reported frequency that leaned toward the "Often (1-2 times/week)" category (CT = 2.88; CIT = 2.73). Those respondents with no UDL training reported frequency within the "Sometimes" (1-2 times/month)" category (M = 2.02). The ANOVA test found a significant difference between groups (F = 32.75 significant at the p<.001 level). Post hoc analysis using the Bonferroni test found a significant difference at the p<.001 level between both respondent groups trained in UDL and those with no UDL training (CT =

2.88; CIT = 2.73; NT = 2.02). Kruskal-Wallis non-parametric analysis confirmed a significant difference ($\chi 2 = 61.31$, df 2, $p < .001$).

Table 21 displays respondents' frequency of technology use in the form of interactive assessments. Twenty-five respondents (3.6%) reported "Do Not Know" or did not answer the question. Both respondent groups that have participated in UDL training reported frequency that tended toward "Sometimes" (CT = 1.76; CIT = 1.93), while those respondents with no UDL training had a lower frequency of use within the "Never" category (M = 1.47). Equal variance could be assured as Levene's test was not statistically significant. The ANOVA test found a significant difference between groups ($F = 18.20$ significant at the $p < .001$ level). Post hoc analysis using the Bonferroni test found a significant difference (significant at the $p < .001$ level) between those currently participating and those with no participation (M = 1.93 and 1.47 respectively). A significant difference was also found (significant at the $p = .001$ level) between those who have completed training and those with no training (M = 1.76 and 1.47 respectively). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi 2 = 39.19$, df 2, $p < .001$).

Table 21 includes the frequency with which respondents reported using technology in the form of web tools, such as wikis, blogs, or social networks. Sixteeen respondents (2.3%) reported "Do Not Know" or did not answer the question. Similar frequency tending toward "Sometimes" was reported from those who have completed training (M = 1.54) and those with no training (M = 1.52). While still within the "Sometimes" category, respondents currently in UDL training had the highest reported frequency (M = 1.77). Equal variance could be assured as Levene's test was not statistically significant. The ANOVA analysis found a significant difference between groups (*F* = 3.67 significant at the $p<.05$ level). Post hoc analysis using the Bonferroni test found a significant difference (significant at the $p<.05$ level) between those currently in training and those with no training (M = 1.77 and 1.52 respectively). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi 2$ = 8.19, df 2, $p<.05$).

Table 21

Perceptions of Technology Use in Schools Based on Level of UDL Training

	UDL - Completed			UDL - Current			No UDL				
Question	N	M	SD	N	M	SD	N	M	SD	df	*F*
Research	110	2.33	0.73	100	2.56	0.83	464	2.16	0.82	2	10.95***
Software programs to learn new skills	109	2.50	0.83	100	2.37	0.85	455	2.08	0.91	2	12.59***
Software programs to reinforce concepts and skills previously learned	108	2.63	0.89	99	2.47	0.81	462	2.20	0.92	2	11.68***
Assessments/tests online	112	2.09	0.79	101	2.07	0.84	465	1.82	0.82	2	7.55***
Homework online	108	1.69	0.91	99	1.90	1.04	457	1.61	0.91	2	3.87*
Multi-media presentations (e.g., Power Point)	111	2.34	0.85	98	2.70	0.90	463	2.24	0.90	2	10.85***
Communications with other students/teachers (e.g., e-mail, blogs, podcasts)	108	2.21	1.19	100	2.31	1.15	465	2.07	1.17	2	2.09
Organization (e.g., graphs, tables, spreadsheets, graphic based organizers)	110	2.40	0.78	101	2.51	0.84	462	2.02	0.93	2	17.35***
Interactive presentation technology (e.g., Smart Boards)	109	2.88	1.14	101	2.73	1.13	462	2.02	1.20	2	32.75***
Interactive assessments (e.g., Classroom Response Systems)	110	1.76	0.77	100	1.93	0.91	456	1.47	0.73	2	18.20***
Web based tools (e.g., wikis, blogs, social networks)	109	1.54	0.75	100	1.77	0.95	466	1.52	0.83	2	3.67*

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 22 displays the mean group responses of the frequency with which other forms of technology are used by respondents. The variables listed in Table 22 were all found to be significant on Levene's test (p<.05). In order to account for unequal variances, the Welch test was used to determine differences between groups. When examining the frequency with which technology is used in the form of word processing, 12 respondents (1.7%) reported "Do Not Know" or did not answer the question. Both respondent groups who had participated in UDL training had similar mean responses that tended toward the "Often" category (CT = 2.81; CIT = 2.89). Respondents with no training in UDL reported frequency of use that tended toward "Sometimes" (M = 2.42). Levene's test was significant (significant at the p<.001 level) leading to the Welch test being used to identify differences. A statistically significant difference was found between groups (Welch F = 16.01, df1 2, df2 207, p<.001). Post hoc analysis using the Tamhane test found significance at the p<.001 level between both respondent groups with UDL training and their colleagues with no participation in UDL training (CT = 2.81; CIT = 2.89; NT = 2.42). This significance was reaffirmed with the non-parametric Kruskal-Wallis test (χ2 = 28.32, df 2, p<.001).

Table 22 reflects respondents' perceptions of how often they utilize technology for drill and practice of specific skills. Twenty respondents (2.9%) reported "Do Not Know" or did not answer the question. Those respondents who were trained in UDL indicated a higher frequency of use (CT = 2.85; CIT = 2.78) that tended toward "Often (1-2 times/week)". Respondents with no training in UDL reported frequency within the "Sometimes (1-2 times/month)" (M = 2.45). The Welch test was used to account for unequal variances as Levene's test was significant at the p<.001 level. A significant difference was found between groups (Welch $F = 11.89$, df1 2, df2 204, $p<.001$). Post hoc analysis using the Tamhane test found a significant difference (significant at the $p<.01$ level) between those currently in UDL training and those with no UDL training (M = 2.78 and 2.45 respectively). A significant difference (significant at the $p<.001$ level) was found between those who have completed training and those with no UDL training (M = 2.85 and 2.45 respectively). Significance was confirmed using the non-parametric Kruskal-Wallis test ($\chi2 = 19.92$, df 2, $p<.001$).

When examining the frequency of the use of text-to-speech programs, 45 respondents (6.5%) indicated “Do Not Know” or did not answer the question. Respondents who have participated in training reported a similar frequency of use that leaned toward the “Sometimes” category (CT = 1.79; CIT = 1.77). Those respondents with no UDL training reported a lower frequency of use within the “Never” category (M = 1.37). Due to the significance of Levene’s test (significant at the $p<.001$ level), the Welch test was utilized to identify differences. The Welch test found a significant difference between groups (Welch $F = 19.15$, df1 2, df2 172, $p<.001$). Post hoc analysis using the Tamhane test revealed a significant difference (significant at the $p<.001$ level) between both respondent groups trained in UDL and those with no training (CT = 1.79; CIT = 1.77; NT = 1.37). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups’ mean ranks ($\chi2 = 47.21$, df 2, $p<.001$).

When examining responses to the frequency of mobile technology use, 26 respondents (3.7%) indicated “Do Not Know” or did not answer the question. CT and CIT respondent groups’ means leaned toward the “Sometimes” range (CT = 1.57; CIT = 1.55), while NT respondents leaned toward “Never” (M = 1.35). The Welch test found a significant difference between groups (Welch $F = 4.72$, df1 2, df2 171, $p<.01$). Post hoc analysis using the Tamhane test revealed a significant difference at the $p<.05$ level between CIT and NT respondents (M = 1.55 and 1.35 respectively), as well as CT and NT respondents (M = 1.57 and 1.35 respectively). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi2 = 9.88$, df 2, $p<.01$).

Table 22

Perceptions of Technology Use in Schools Based on Level of Participation in UDL Training

	UDL - Completed			UDL - Current			No UDL					
Question	N	M	SD	N	M	SD	N	M	SD	df1	df2	Welch *F*
Word Processing	111	2.81	0.76	101	2.89	1.00	467	2.42	1.00	2	206.73	16.01***
Drill and practice of specific skills	109	2.85	0.85	100	2.78	0.87	462	2.45	1.00	2	204.07	11.89***
Text-to-speech programs	104	1.79	0.88	100	1.77	0.78	442	1.37	0.68	2	172.14	19.15***
Mobile technology (e.g., Palm Pilots, ipods)	107	1.57	0.91	99	1.55	0.82	459	1.35	0.70	2	171.20	4.72**

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Further analyses were conducted that examined variables based on respondents' level of UDL training and their categorization as general education or special education, as well as their categorization as administrator or teacher. Table 23 summarizes the frequency with which respondents reported utilizing technology for the purpose of word processing based on categorization as general education or special education. Both respondent groups of special educators, as well as general educators trained in UDL reported use within or tending toward the "Often" range (SpUDL = 3.00; SpNoUDL = 2.96; GenUDL = 2.80). General educators with no UDL training reported frequency within the "Sometimes" category (M = 2.32). The mean of those respondents trained in

UDL was nearly .5 higher than those with no training in the simplest of technology uses within schools—using a word processor. Kruskal-Wallis analysis identified a statistically significant difference in respondent groups' mean ranks ($\chi 2 = 55.27$, df 2, $p<.001$). Special educators reported the highest frequency of use supported by mean ranks, while general educators reported the lowest frequency of use in the use of word processors.

Table 23

General Education/Special Education Frequency of Technology Use for Word Processing

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	161	2.80	0.91	386.98		
Sp Ed (UDL)	51	3.00	0.77	427.63	3	55.27***
Gen Ed (no UDL)	396	2.32	0.97	295.60		
Sp Ed (no UDL)	71	2.96	1.01	418.15		
Total	679	2.55	0.98			

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 24 summarizes the frequency with which administrators and teachers reported technology use for the purpose of word processing. Both groups of administrators reported the highest frequency of word processing use in classrooms which fell in the "Often" category (UDL = 3.40; NoUDL= 3.41). Teachers with UDL training reported frequency that leaned toward the "Often" category (M = 2.69), while teachers with no UDL training had mean responses within the "Sometimes" category (M = 2.37). The Kruskal-Wallis test found a significant difference between respondent groups' mean ranks ($\chi 2 = 70.89$, df 3, $p<.001$). Administrators reported the highest frequency of use supported by mean ranks, while teachers with no UDL training reported the lowest frequency of use in terms of use of word processing.

Table 24

Administrator/Teacher Frequency of Technology Use for Word Processing

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	3.40	0.68	503.26		
Teacher (UDL)	165	2.69	0.87	366.42	3	70.89***
Admin (no UDL)	22	3.41	0.67	504.73		
Teacher (no UDL)	445	2.37	0.99	304.82		
Total	679	2.55	0.98			

Note. *p<.05, **p<.01, ***p<. 001

Table 25 summarizes the frequency with which teachers reported utilizing technology for the purpose of research based on their categorization as general education or special education. All respondent groups' means were within the "Sometimes (1-2 times/month)" category with those respondents trained in UDL reporting higher frequency of use (Gen = 2.44; Sp = 2.43) than respondents with no training in UDL (Gen = 2.15; Sp = 2.17). Kruskal-Wallis analysis found a statistically significant difference between respondent groups' mean ranks ($\chi 2$ = 20.22, df 3, p<.001). Both respondent groups trained in UDL reported stronger frequency ratings supported by mean ranks than respondents with no participation.

Table 25

General Education/Special Education Frequency of Technology Use for Research

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	161	2.44	0.77	386.64		
Sp Ed (UDL)	49	2.43	0.84	373.21	3	20.22***
Gen Ed (no UDL)	394	2.15	0.81	316.49		
Sp Ed (no UDL)	70	2.17	0.88	317.74		
Total	674	2.24	0.82			

Note. *p<.05, **p<.01, ***p<. 001

Table 26 summarizes the frequency with which administrators and teachers reported technology use for the purpose of research. Both groups of administrators reported the highest frequency of word processing use in classrooms (UDL = 2.81; NoUDL= 2.64) tending toward the “Often” category. Both groups of teachers reported frequency of use within the “Sometimes” category (UDL = 2.33; NoUDL = 2.13). The Kruskal-Wallis test found a significant difference between groups ($\chi 2 = 43.43$, df 3, $p<.001$). Administrators trained in UDL reported the strongest frequency ratings supported by mean ranks, while teachers with no UDL training reported the lowest frequency ratings.

Table 26

Administrator/Teacher Frequency of Technology Use for Research

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	2.81	0.68	466.56		
Teacher (UDL)	163	2.33	0.79	359.56	3	43.43***
Admin (no UDL)	22	2.64	0.58	437.64		
Teacher (no UDL)	442	2.13	0.83	310.66		
Total	674	2.24	0.82			

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 27 summarizes the frequency with which teachers reported utilizing technology for the purpose of drill and practice based on categorization as general education or special education. Respondents trained in UDL reported a higher frequency of use (Gen = 2.76; Sp = 3.00) than respondents with no training in UDL (Gen = 2.41; Sp = 2.69). Kruskal-Wallis analysis identified a statistically significant difference between respondent groups’ mean ranks ($\chi 2 = 27.20$, df 3, $p<.001$). Special educators trained in UDL reported the strongest frequency based on mean ranks, while general educators with no training in UDL reported the weakest frequency of technology use for drill and practice.

Table 27

General Education/Special Education Frequency of Technology Use for Drill and Practice

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	159	2.76	0.87	372.05		
Sp Ed (UDL)	50	3.00	0.78	418.97	3	27.20***
Gen Ed (no UDL)	390	2.41	0.99	306.20		
Sp Ed (no UDL)	72	2.69	0.97	360.20		
Total	671	2.57	0.97			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 28 summarizes the frequency with which administrators and teachers reported technology use for the purpose of drill and practice. Both groups of administrators reported the highest frequency of drill and practice technology use in classrooms (UDL = 3.00; NoUDL= 3.19) falling in the “Often” category. Teachers trained in UDL reported frequency of use that tended toward the “Often” category (M = 2.77), while teachers with no UDL training reported frequency within the “Sometimes” category (M = 2.42). The Kruskal-Wallis test found a significant difference between respondent groups’ mean ranks ($\chi 2$ = 34.05, df 3, *p*<.001). Administrators with no UDL training reported the highest frequency of use supported by mean ranks, while teachers with no UDL training reported the lowest frequency of technology use for the purposes of drill and practice.

Table 28

Administrator/Teacher Frequency of Technology Use for Drill and Practice

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	45	3.00	0.71	419.23		
Teacher (UDL)	164	2.77	0.89	373.41	3	34.05***
Admin (no UDL)	21	3.19	0.81	453.31		
Teacher (no UDL)	441	2.42	0.99	308.01		
Total	671	2.57	0.97			

Note. *p <.05, **p <.01, ***p<. 001

Table 29 summarizes the frequency with which respondents reported utilizing technology through the use of software for new skills and based on their categorization as general education or special education. Special education respondents trained in UDL reported frequency leaning toward the "Often" category (M = 2.67). Other respondent groups reported frequency within the "Sometimes" range with those respondents trained in UDL reporting higher frequency of use (Gen = 2.37) than those respondents with no UDL training (Gen = 2.04; Sp = 2.29). Kruskal-Wallis analysis found a statistically significant difference in respondent groups' mean ranks ($\chi2$ = 33.60, df 3, p<.001). Both respondent groups trained in UDL reported stronger frequency of technology use through software for new skills supported by mean ranks than did respondents with no UDL training.

Table 29

General Education/Special Education Frequency of Technology Use of Software for New Skills

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	160	2.37	0.81	372.48		
Sp Ed (UDL)	49	2.67	0.90	424.91	3	33.60***
Gen Ed (no UDL)	387	2.04	0.91	300.45		
Sp Ed (no UDL)	68	2.29	0.90	354.25		
Total	664	2.19	0.90			

Note. *p <.05, **p <.01, ***p<. 001

Table 30 summarizes the frequency with which administrators and teachers reported technology use in the form of software to teach new skills. Both groups of administrator respondents reported the highest frequency of software use in classrooms to teach new skills that tended toward the “Often” category (UDL = 2.62; NoUDL= 2.68). Both groups of teacher respondents had mean group responses in the “Sometimes” range (UDL = 2.39; NoUDL = 2.05). The Kruskal-Wallis test found a significant difference between groups ($\chi 2$ = 39.95, df 3, p<.001). Based on mean ranks, both respondent groups of administrators reported higher frequency of technology use in the form of software to teach new skills than did either group of teachers.

Table 30

Administrator/Teacher Frequency of Technology Use of Software for New Skills

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	2.62	0.74	425.49		
Teacher (UDL)	162	2.39	0.87	372.96	3	39.95***
Admin (no UDL)	22	2.68	0.72	436.50		
Teacher (no UDL)	433	2.05	0.91	301.99		
Total	664	2.19	0.90			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 31 summarizes the frequency with which teachers reported utilizing technology in the form of software to reinforce previously taught content. Analysis was based on respondents' classification as general education or special education. Special educators trained in UDL reported the highest frequency of use that tended toward the "Often" category (M = 2.79), while all other respondent groups' means were within the "Sometimes" category (GenUDL = 2.48; GenNoUDL = 2.18; SpNoUDL = 2.33). Kruskal-Wallis analysis found a statistically significant difference in respondent groups' mean ranks ($\chi2 = 26.59$, df 3, $p<.001$). Both respondent groups trained in UDL reported higher frequency of use supported by mean ranks than did respondents with no UDL training.

Table 31

General Education/Special Education Frequency of Technology Use of Software to Reinforce Previously Taught Skills

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	159	2.48	0.83	371.90		
Sp Ed (UDL)	48	2.79	0.92	426.22	3	26.59***
Gen Ed (no UDL)	393	2.18	0.93	308.39		
Sp Ed (no UDL)	69	2.33	0.87	338.10		
Total	669	2.31	0.92			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 32 summarizes the frequency with which administrators and teachers reported using technology in the form of software to reinforce previously taught skills. Both respondent groups of administrators reported the highest frequency of software use in classrooms to reinforce skills (UDL = 2.67; NoUDL= 2.91) that tended toward the "Often" range. Teachers trained in UDL also had mean group responses that leaned toward "Often" (M = 2.52), while teachers with no UDL training had a mean group response within the "Sometimes" category (M = 2.17). The Kruskal-Wallis test found a significant difference between groups ($\chi 2$ = 38.54, df 3, *p*<.001). Based on mean ranks, both respondent groups of administrators reported more frequency of software use to reinforce skills than did both respondent groups of teachers.

Table 32

Administrator/Teacher Frequency of Technology Use of Software to Reinforce Previously Taught Skills

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	46	2.67	0.70	416.55		
Teacher (UDL)	161	2.52	0.90	375.34	3	38.54***
Admin (no UDL)	22	2.91	0.68	460.23		
Teacher (no UDL)	440	2.17	0.92	305.45		
Total	669	2.31	0.92			

Note. *p <.05, **p <.01, ***p<. 001

Table 33 summarizes the frequency with which respondents reported utilizing technology for assessments/tests online based on categorization as general education or special education. All respondent groups trained in UDL reported using technology for assessments/tests online within the “Sometimes (1-2 times/month)” category (Gen = 2.01; Sp = 2.29). Respondents with no training in UDL reported frequency of use that tended toward “Sometimes” (Gen = 1.81; Sp = 1.88). Kruskal-Wallis analysis identified a statistically significant difference between respondent groups’ mean ranks ($\chi 2$ = 21.44, df 3, p<.001). Both respondent groups trained in UDL reported higher frequency supported by mean ranks than did those respondents with no training in UDL in their use of technology in assessments/tests online.

Table 33

General Education/Special Education Frequency of Technology Use for Assessments/Tests Online

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	162	2.01	0.76	371.09		
Sp Ed (UDL)	51	2.29	0.92	421.11	3	21.44***
Gen Ed (no UDL)	397	1.81	0.82	316.86		
Sp Ed (no UDL)	68	1.88	0.82	335.21		
Total	678	1.90	0.83			

Note. *p <.05, **p <.01, ***p<. 001

Table 34 summarizes the frequency with which administrators and teachers reported technology in the form of assessments/tests online. Both respondent groups of administrators indicated frequency within the “Sometimes” (UDL = 2.43; NoUDL = 2.27). Teachers trained in UDL also reported frequency within the “Sometimes” category (M = 2.02), while teachers with no training in UDL reported frequency that tended toward “Sometimes” (M = 1.79). The Kruskal-Wallis test found a significant difference between groups ($\chi 2$ = 37.09, df 3, p<.001). Both respondent groups of administrators reported higher frequency of use supported by mean ranks than did teachers in terms of technology use in the form of assessments/tests online.

Table 34

Administrator/Teacher Frequency of Technology Use for Assessments/Tests Online

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	2.27	0.68	434.56		
Teacher (UDL)	165	2.02	0.84	368.09		
Admin (no UDL)	23	2.43	0.79	458.54	3	37.09***
Teacher (no UDL)	442	1.79	0.81	312.31		
Total	678	1.90	0.83			

Note. *p <.05, **p <.01, ***p<. 001

Table 35 summarizes the frequency with which respondents reported utilizing technology for homework online. Analysis was based on respondents' categorization as general education or special education. All respondent groups' trained in UDL indicated frequency that tended toward the "Sometimes" category (Gen = 1.73; Sp = 1.98). General educators with no UDL training also reported frequency that tended toward "Sometimes" (M = 1.64), while special educators with no training in UDL reported frequency within the "Never" category (M = 1.45). Kruskal-Wallis non-parametric analysis found a statistically significant difference in respondent groups' mean ranks ($\chi 2$ = 37.09, df 3, p<.001). Based on mean ranks, respondents trained in UDL reported higher frequency of technology use for the purpose of homework online than did respondents with no training in UDL.

Table 35

General Education/Special Education Frequency of Technology Use for Homework Online

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	157	1.73	0.94	346.24		
Sp Ed (UDL)	50	1.98	1.10	384.83	3	10.17*
Gen Ed (no UDL)	390	1.64	0.93	327.37		
Sp Ed (no UDL)	67	1.45	0.78	291.13		
Total	664	1.67	0.93			

Note. *p <.05, **p <.01, ***p<. 001

Table 36 summarizes the frequency with which administrators and teachers reported technology use in the form of homework online. Administrators reported the highest frequency that fell within the "Sometimes" category (UDL = 2.11; NoUDL = 2.32). Both respondent groups of teachers reported frequency that tended toward "Sometimes" (UDL = 1.70; NoUDL = 1.58). The Kruskal-Wallis test found a significant difference between groups ($\chi2$ = 29.19, df 3, p<.001). Both respondent groups of administrators indicated higher frequency supported by mean ranks than did both respondent groups of teachers.

Table 36

Administrator/Teacher Frequency of Technology Use for Homework Online

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	45	2.11	1.01	420.56		
Teacher (UDL)	162	1.70	0.96	337.51	3	29.19***
Admin (no UDL)	22	2.32	0.99	459.11		
Teacher (no UDL)	435	1.58	0.89	315.12		
Total	664	1.67	0.93			

Note. *p <.05, **p <.01, ***p<. 001

Table 37 summarizes the frequency with which respondents reported utilizing technology for multimedia presentations. Analysis was based on categorization as general education or special education. Special educators trained in UDL reported frequency that tended toward the “Often” category (M = 2.57). All other respondent groups reported frequency of use within the “Sometimes” category (GenUDL = 2.49; GenNoUDL = 2.25, SpNoUDL = 2.19). Kruskal-Wallis non-parametric analysis found a statistically significant difference between respondent groups’ mean ranks ($\chi2 = 13.21$, df 3, $p<.01$). Based on mean ranks, both respondent groups trained in UDL reported higher frequency of technology use for multimedia presentations than did respondent groups not trained in UDL.

Table 37

General Education/Special Education Frequency of Technology Use for Multimedia Presentations

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	160	2.49	0.88	369.92		
Sp Ed (UDL)	49	2.57	0.94	386.63	3	13.21**
Gen Ed (no UDL)	394	2.25	0.91	321.09		
Sp Ed (no UDL)	69	2.19	0.79	311.41		
Total	672	2.33	0.90			

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 38 summarizes the frequency with which administrators and teachers reported technology use in the form of multimedia presentations. Both groups of administrators reported frequency that tended toward the “Often” category (UDL = 2.79; NoUDL = 2.82), while both groups of teachers reported frequency within the “Sometimes” category (UDL = 2.43; NoUDL = 2.22). The Kruskal-Wallis test found a significant difference between respondent groups' mean ranks ($\chi2 = 29.51$, df 3, $p<.001$). Both respondent groups of administrators reported higher frequency of technology use for multimedia presentations based on mean ranks than did either group of teacher respondents.

Table 38

Administrator/Teacher Frequency of Technology Use for Multimedia Presentations

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	2.79	0.77	435.75		
Teacher (UDL)	161	2.43	0.91	355.38	3	29.51***
Admin (no UDL)	22	2.82	0.80	437.05		
Teacher (no UDL)	441	2.22	0.89	313.79		
Total	672	2.33	0.90			

Note. *$p<.05$, **$p<.01$, ***$p<.001$

Table 39 summarizes the frequency with which respondents reported utilizing technology for communication with other students/teachers. Analysis was based on categorization as general education or special education. Both respondent groups trained in UDL, as well as special educators with no training in UDL had the same mean group responses within the "Sometimes" category (M = 2.26). General educators with no UDL training had the lowest reported frequency, though still within the "Sometimes" range (M = 2.04). Kruskal-Wallis non-parametric analysis identified no statistically significant difference in respondent groups' mean ranks in terms of technology use for communication purposes ($\chi2 = 6.43$, df 3).

Table 39

General Education/Special Education Frequency of Technology Use for Communication

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	158	2.26	1.16	360.37		
Sp Ed (UDL)	50	2.26	1.21	356.29	3	6.43
Gen Ed (no UDL)	396	2.04	1.15	321.99		
Sp Ed (no UDL)	69	2.26	1.28	355.66		
Total	673	2.13	1.17			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 40 summarizes the frequency with which administrators and teachers reported technology for the purpose of communication. Administrators with no training in UDL reported the highest frequency which tended toward the "Often" category (M = 2.67). The other respondents groups indicated frequency within the "Sometimes" category (TchUDL = 2.22; AdmUDL = 2.38; TchNoUDL = 2.04). The Kruskal-Wallis test found a significant difference between respondent groups' mean ranks ($\chi2$ = 12.66, df 3, *p*<.01). Both groups of administrators reported higher frequency of technology use for communication based on mean ranks than did both groups of teachers.

Table 40

Administrator/Teacher Frequency of Technology Use for Communication

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	2.38	1.07	386.66		
Teacher (UDL)	161	2.22	1.20	351.43	3	12.66**
Admin (no UDL)	21	2.67	1.02	430.07		
Teacher (no UDL)	444	2.04	1.17	322.11		
Total	673	2.13	1.17			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 41 summarizes the frequency with which respondents reported utilizing technology for text-to-speech programs based on their categorization as general education or special education. Special educators trained in UDL reported frequency of use within the "Sometimes" category (M = 2.20), while special educators with no UDL training reported frequency that tended toward "Sometimes" (M = 1.80). General education respondents trained in UDL also reported frequency tending toward "Sometimes," while those who have not participated in UDL training were within the "Never" category (GenUDL = 1.64; GenNoUDL = 1.29). Kruskal-Wallis non-parametric analysis identified a statistically significant difference between respondent groups' mean ranks ($\chi 2$ = 85.53, df 3, p<.001). Based on mean ranks, special educators trained in UDL reported the highest frequency of technology use for text-to-speech programs, while general educators with no UDL training reported the lowest frequency of use.

Table 41

General Education/Special Education Frequency of Technology Use for Text-to-Speech Programs

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	154	1.64	0.74	362.95		
Sp Ed (UDL)	50	2.20	0.95	459.10	3	85.53***
Gen Ed (no UDL)	373	1.29	0.60	278.33		
Sp Ed (no UDL)	69	1.80	0.90	381.38		
Total	646	1.50	0.75			

Note. *p <.05, **p <.01, ***p<. 001

Table 42 summarizes the frequency with which administrators and teachers reported technology use for the purpose of communication. Administrators and teachers with UDL training, as well as administrators with no UDL training reported frequency within or tending toward the "Sometimes" category (M = 2.09, 1.69, and 1.78 respectively). Teachers with no UDL training reported the weakest frequency which fell within the "Never" category (M = 1.35). The Kruskal-Wallis test found a significant difference between groups ($\chi2$ = 70.18, df 3, *p*<.001). Based on mean ranks, both respondent groups of administrators reported the highest frequency of technology use for text-to-speech programs. Teachers reported less frequent use, with teachers with no UDL training reported the lowest frequency of use supported by mean ranks.

Table 42

Administrator/Teacher Frequency of Technology Use for Text-to-Speech Programs

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	44	2.09	0.68	469.86		
Teacher (UDL)	160	1.69	0.85	363.60	3	70.18***
Admin (no UDL)	18	1.78	0.81	395.44		
Teacher (no UDL)	424	1.35	0.67	290.13		
Total	646	1.50	0.75			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 43 summarizes the frequency with which teachers reported utilizing technology for organization through such means as graphs, tables, and graphic organizers. Respondents trained in UDL reported higher frequency of usage that fell within the "Sometimes (1-2 times/month)" category (Gen = 2.50; Sp = 2.30). Those respondents with no UDL training also reported frequency within or tending toward "Sometimes" (Gen = 1.99; Sp = 2.14). Kruskal-Wallis non-parametric analysis found a statistically significant difference in respondent groups' mean ranks ($\chi2$ = 41.35, df 3, *p*<.001). Based on mean ranks, both respondent groups trained in UDL reported higher frequency of technology use for the purpose of organization than did respondents not trained in UDL.

Table 43

General Education/Special Education Frequency of Technology Use for Organization

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	161	2.50	0.81	411.80		
Sp Ed (UDL)	50	2.30	0.81	370.72	3	41.35***
Gen Ed (no UDL)	392	1.99	0.91	303.23		
Sp Ed (no UDL)	70	2.14	1.03	329.98		
Total	673	2.15	0.92			

Note. *p <.05, **p <.01, ***p<. 001

Table 44 summarizes the frequency with which administrators and teachers reported technology for the purpose of organization. Both groups of administrator respondents reported frequency that tended toward the “Often” category (UDL = 2.67; NoUDL = 2.55). Both groups of teacher respondents reported frequency that fell within or leaned toward the “Sometimes” category (UDL = 2.39; NoUDL = 1.99). The Kruskal-Wallis test found a significant difference between groups ($\chi 2$ = 50.64, df 3, p<.001). Both respondent groups of administrators reported higher frequency of technology usage for organization based on mean ranks than did teacher respondents.

Table 44

Administrator/Teacher Frequency of Technology Use for Organization

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	2.67	0.75	448.49		
Teacher (UDL)	163	2.39	0.82	388.39	3	50.64***
Admin (no UDL)	22	2.55	0.74	419.18		
Teacher (no UDL)	440	1.99	0.93	301.69		
Total	673	2.15	0.92			

Note. *p <.05, **p <.01, ***p<. 001

Table 45 summarizes the frequency with which respondents reported utilizing technology for interactive presentation technology based on categorization as general education or special education. General educators who have been trained in UDL have a mean group response (M = 2.89) that is .86 higher than general educators with no training (M = 2.03). Special educators trained in UDL also reported a higher frequency of use (M = 2.54) than special educators with no training in UDL (M = 1.97). Kruskal-Wallis non-parametric analysis identified a statistically significant difference in respondent groups' mean ranks ($\chi 2$ = 63.67, df 3, p<.001). Based on mean ranks, both respondent groups trained in UDL reported a higher frequency of technology use for interactive presentations than respondents with no UDL training.

Table 45

General Education/Special Education Frequency of Technology Use for Interactive Presentations

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	160	2.89	1.13	431.24		
Sp Ed (UDL)	50	2.54	1.13	379.17	3	63.67***
Gen Ed (no UDL)	392	2.03	1.21	300.02		
Sp Ed (no UDL)	70	1.97	1.14	293.79		
Total	672	2.27	1.23			

Note. *p <.05, **p <.01, ***p<. 001

Table 46 summarizes the frequency with which administrators and teachers reported technology use in the form of interactive presentation technology. Both groups of administrator respondents reported frequency within the “Often” range (UDL = 3.11; NoUDL = 3.14). Teachers trained in UDL had mean responses that tended toward “Often” (M = 2.72), while those teachers with no UDL training had mean responses that leaned toward “Sometimes” (M = 1.96). The Kruskal-Wallis test found a significant difference between respondent groups’ mean ranks ($\chi 2$ = 84.07, df 3, p<.001). Both groups of administrators reported higher frequency of technology use for interactive presentations based on mean ranks than did both groups of teacher respondents.

Table 46

Administrator/Teacher Frequency of Technology Use for Interactive Presentations

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	47	3.11	0.79	468.52		
Teacher (UDL)	163	2.72	1.21	404.52	3	84.07***
Admin (no UDL)	22	3.14	1.04	467.30		
Teacher (no UDL)	440	1.96	1.18	290.66		
Total	672	2.27	1.23			

Note. *p <.05, **p <.01, ***p<. 001

Table 47 summarizes the frequency with which respondents reported utilizing mobile technology such as Palm Pilots or ipods based on categorization as general education or special education. Respondents trained in UDL reported frequency that leaned toward “Sometimes” (Gen=1.56; Sp = 1.56), while those respondents with no UDL training reported frequency within the “Never” category (Gen = 1.33; Sp = 1.43). Kruskal-Wallis non-parametric analysis identified a statistically significant difference in respondent groups’ mean ranks ($\chi 2 = 11.60$, df 3, p<.01). Based on mean ranks, both respondent groups trained in UDL reported higher frequency of technology usage for mobile technology than did both respondent groups not trained in UDL.

Table 47

General Education/Special Education Frequency of Mobile Technology Use

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	156	1.56	0.89	357.81		
Sp Ed (UDL)	50	1.56	0.81	368.11	3	11.60**
Gen Ed (no UDL)	390	1.33	0.69	317.01		
Sp Ed (no UDL)	69	1.43	0.74	341.86		
Total	665	1.41	0.76			

Note. *p <.05, **p <.01, ***p<. 001

Table 48 summarizes the frequency with which administrators and teachers reported technology use in the form of mobile technology. Both groups of administrator respondents reported frequency of usage that tended toward the “Sometimes” category (UDL = 1.74; NoUDL = 1.80). Teachers trained in UDL also reported frequency that tended toward “Sometimes” (M = 1.51), while those teachers with no UDL training had mean responses within the “Never” category (M = 1.33). The Kruskal-Wallis test found a significant difference between respondent groups’ mean ranks ($\chi 2$ = 28.90, df 3, p<.001). Both respondent groups of administrators reported higher frequency of mobile technology use based on mean ranks than did both respondent groups of teachers.

Table 48

Administrator/Teacher Frequency of Mobile Technology Use

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	46	1.74	0.83	413.17	3	28.90***
Teacher (UDL)	160	1.51	0.88	345.11		
Admin (no UDL)	20	1.80	0.83	433.70		
Teacher (no UDL)	439	1.33	0.68	315.60		
Total	665	1.41	0.76			

Note. *p<.05, **p<.01, ***p<. 001

Table 49 summarizes the frequency with which respondents reported utilizing technology for interactive assessments, such as classroom response systems. Analysis was based on respondents’ categorization as general education or special education. Respondents trained in UDL indicated higher frequency of use which tended toward “Sometimes” (Gen = 1.89; Sp = 1.68). Respondents with no UDL training had mean responses within the “Never” category (Gen = 1.47; Sp = 1.47). Kruskal-Wallis analysis identified a statistically significant difference in respondent groups’ mean ranks ($\chi 2$ =

40.64, df 3, *p*<.001). Based on mean ranks, both respondent groups trained in UDL reported higher frequency of interactive assessment technology than did respondent groups with no training in UDL.

Table 49

General Education/Special Education Frequency of Technology Use for Interactive Assessments

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	160	1.89	0.86	403.88		
Sp Ed (UDL)	50	1.68	0.77	361.21	3	40.64***
Gen Ed (no UDL)	390	1.47	0.73	305.86		
Sp Ed (no UDL)	66	1.47	0.75	305.23		
Total	666	1.59	0.79			

Note. *p<.05, **p<.01, ***p<. 001

Table 50 summarizes the frequency with which administrators and teachers reported technology use in the form of interactive presentation technology. Both groups of administrator respondents reported frequency of use within the “Sometimes” range (UDL = 2.11; NoUDL = 2.14). Teachers trained in UDL indicated frequency that tended toward “Sometimes” (M = 1.77), while those teachers with no UDL training indicated the weakest frequency of use that fell within the “Never” category (M = 1.44). The Kruskal-Wallis test found a significant difference between groups ($\chi 2$ = 71.85, df 3, *p*<.001). Both respondent groups of administrators reported higher frequency of interactive assessment technology use than both respondent groups of teachers based on mean ranks.

Table 50

Administrator/Teacher Frequency of Technology Use for Interactive Assessments

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	46	2.11	0.71	467.85		
Teacher (UDL)	164	1.77	0.86	372.93	3	71.85***
Admin (no UDL)	22	2.14	0.71	473.84		
Teacher (no UDL)	434	1.44	0.72	297.25		
Total	666	1.59	0.79			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 51 summarizes the frequency with which respondents reported utilizing technology in the form of web tools, such as wikis, blogs, or social networks. Analysis was based on respondents' categorization as general education or special education. All respondent groups' indicated frequency that tended toward the "Sometimes" category (GenUDL = 1.63; SpUDL= 1.71; GenNoUDL = 1.52; SpNoUDL = 1.54). Kruskal-Wallis non-parametric analysis indicated no significant difference in respondent groups' mean ranks ($\chi 2 = 5.80$, df 3).

Table 51

General Education/Special Education Frequency of Technology Use in the Form of Web Tools

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	160	1.63	0.85	357.17		
Sp Ed (UDL)	49	1.71	0.89	371.99	3	5.80
Gen Ed (no UDL)	395	1.52	0.82	328.16		
Sp Ed (no UDL)	71	1.54	0.88	326.10		
Total	675	1.56	0.84			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 52 summarizes the frequency with which administrators and teachers reported technology use in the form of web tools. Both groups of administrator respondents reported higher frequency of web tool use that fell within the “Sometimes” category (UDL = 2.09; NoUDL = 2.05). Teachers reported frequency that tended toward “Sometimes” (UDL = 1.53; NoUDL = 1.50). The Kruskal-Wallis test found a significant difference between groups ($\chi2 = 39.28$, df 3, $p<.001$). Both respondent groups of administrators reported higher frequency of technology use in the form of web tools based on mean ranks than both respondent groups of teachers.

Table 52

Administrator/Teacher Frequency of Technology Use in the Form of Web Tools

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	46	2.09	0.89	458.54		
Teacher (UDL)	163	1.53	0.81	333.02	3	39.28***
Admin (no UDL)	21	2.05	0.80	460.67		
Teacher (no UDL)	445	1.50	0.82	321.58		
Total	675	1.56	0.84			

Note. *p <.05, **p <.01, ***p<. 001

Summary

The results of these analyses suggest that training in UDL impacts technology use within classrooms. Analysis was completed that examined specific forms of technology and perceptions of respondents at different levels of UDL training, including currently participating in training, completed training, and no training. Eleven of fifteen variables (73%) had a significant difference between both respondent groups trained in UDL (CT and CIT) and those respondents with no UDL training (NT). Three of fifteen variables had a significant difference between those currently in UDL training (CIT) and those with no UDL training (NT). CT respondents only reported significantly higher frequency of use than NT respondents in variables in which CIT respondents also reported significantly higher frequency. Both respondent groups with training in UDL indicated significantly more use of technology for research, software programs to learn new skills, software programs to reinforce concepts previously learned, assessments/tests online, organization, interactive presentation technology, interactive assessments, word processing, drill and practice of specific skills, text-to-speech programs, and mobile technology. CIT respondents reported significantly different frequency of use than NT respondents in homework online, multi-media presentations, and web tools.

Analyses that examined respondents' perceptions based on categorization as general education or special education identified several areas where differences existed. Significant differences were found in the frequency that technology is used to provide more choice and flexibility to students, present material in ways that support all students learning, and allow students to express what they have learned. Analyses examining the frequency of various technology uses identified significant differences were identified between groups in the following areas: word processing, research, drill and practice, software to teach new skills, software to reinforce previously taught skills, assessments/tests online, homework online, and multi-media presentations.

Exploratory analyses identified differences in respondents' perceptions based on classification as administrators or teachers. There were significant differences among all variables in frequency of use between respondent groups. In all variables for both groups (UDL trained and UDL not trained), administrators reported higher frequency of technology use than did teachers. When examining respondents trained in UDL, administrators reported a higher frequency of use by at least 0.5 on the four-point scale in two variables (word processing and web tools). When examining respondents with no training in UDL, administrators reported a higher frequency of technology use by at least .5 on 12 out of 15 variables (word processing, research, drill and practice, software for new skills, software to reinforce, assessments online, homework online, multimedia presentations, communication, organization, interactive assessment, and web tools).

Research Question 3

Are there differences in faculty perceptions of students' level of engagement in classroom activities between those who have participated in UDL professional development and those who have not?

Table 53 displays an analysis of respondents' perceptions that more choice in instruction and assessment lead to more student engagement in the material being presented. Twenty-five respondents (3.6%) indicated "Do Not Know" or did not answer the question. The assumption of equal variance was not met as Levene's test was significant ($p<.001$). Respondents with training in UDL had similar levels of agreement that tended toward the "Strongly Agree" category (CT = 3.65; CIT = 3.67). Respondents with no UDL training had a lower level of agreement that fell within the "Agree" category (M = 3.40). The Welch test was completed to account for unequal variance and found a significant difference between groups (Welch $F = 12.78$, df1 2, df2 205, $p<.001$). Post hoc analysis using the Tamhane test found both respondent groups trained in UDL were significantly different than those with no training at the $p<.001$ level (CT = 3.65; CIT = 3.67; NT = 3.40). Kruskal-Wallis analysis confirmed that there were significant differences in respondent groups' mean ranks ($\chi2 = 25.43$, df 2, $p<.001$).

Table 53

Perceptions of the Impact of Student Choice in Instruction and Assessment on Level of Engagement Based on Level of UDL Training

	UDL - Completed			UDL - Current			No UDL					
Question	N	M	SD	N	M	SD	N	M	SD	df1	df2	Welch *F*
The more choice that students have in their instruction and assessment, the more engaged they will be in the material being presented.	110	3.65	0.57	98	3.67	0.61	458	3.40	0.70	2	205.28	12.78***

Note. $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

Table 54 summarizes respondents' perceptions about the impact of student choice in instruction and assessment on students' level of engagement. Analysis is based on respondents' categorization as general education or special education, as well as their level of UDL training. Special educators and general educators with training in UDL had the highest level of agreement that tended toward the "Strongly Agree" category (M = 3.69 and 3.65 respectively). Special educators with no training also reported a level of agreement tending toward "Strongly Agree" (M = 3.58), while general educators with no training in UDL reported agreement within the "Agree" range (M = 3.36). Kruskal-Walis analysis identified a significant difference in respondent groups' mean ranks ($\chi2$ = 32.05, df 2, *p*<.001). Special educators trained in UDL reported the strongest level of agreement supported by mean ranks, while general educators with no training reported the weakest agreement.

Table 54

General Education/Special Education Perceptions of the Impact of Student Choice in Instruction and Assessment on Level of Engagement

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	157	3.65	0.59	379.47		
Sp Ed (UDL)	51	3.69	0.58	390.71	3	32.05***
Gen Ed (no UDL)	387	3.36	0.70	302.59		
Sp Ed (no UDL)	71	3.58	0.62	359.24		
Total	666	3.48	0.67			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 55 summarizes respondents' perceptions regarding the impact of choice in instruction and assessment on students' level of engagement in the material being presented. Analysis is based on respondents' categorization as administrators and teachers, as well as their level of UDL training. Both respondent groups with training in UDL indicated the highest level of agreement which tended toward "Strongly Agree" (AdUDL = 3.76; TchUDL = 3.63). Strength of agreement was lower in respondents with no training in UDL, but were still in the "Agree" range (AdNoUDL = 3.43; TchNoUDL = 3.39). Kruskal-Wallis analysis found a significant difference between respondent groups' mean ranks ($\chi 2 = 26.91$, df 2, p<.001). Based on mean ranks, both respondent groups trained in UDL reported stronger levels of agreement than those respondent groups not trained in UDL.

Table 55

Administrator/Teacher Perceptions of the Impact of Student Choice in Instruction and Assessment on Level of Engagement

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	46	3.76	0.48	408.57		
Teacher (UDL)	162	3.63	0.61	374.75	3	26.91***
Admin (no UDL)	23	3.43	0.79	331.04		
Teacher (no UDL)	435	3.39	0.69	310.33		
Total	666	3.48	0.67			

Note. $*p<.05$, $**p<.01$, $***p<.001$

Table 56 displays respondents' perceptions on the frequency with which technology is utilized to present material in engaging ways to students. Seventeen respondents (2.4%) indicated "Do Not Know" or did not answer the question. The remaining responses (n=674) were considered valid for statistical analysis. Equal variance was assured as Levene's test was not statistically significant. Respondents who have completed UDL training indicated the highest frequency of technology use to present material in ways that actively engage learners (M = 3.39), while those respondents currently in training indicated a lower frequency of use (M = 3.24). While still in the "Often (1-2 times/week)" range, respondents with no UDL training had the lowest level of agreement (M = 3.14). The ANOVA analysis found a significant difference between groups ($F = 4.30$ significant at the $p<.01$ level). Post hoc analysis using the Bonferroni test found a significant difference (significant at the $p<.05$ level) between those who completed UDL training (M = 3.39) and those with no UDL training (M = 3.14). Kruskal-Wallis non-parametric analysis confirmed significance between respondent groups' mean ranks ($\chi 2 = 8.69$, df 2, $p<.05$).

Table 56

Perceptions of Technology's Impact on Student Engagement Based on Level of UDL Training

	UDL - Completed			UDL - Current			No UDL				
Question	N	M	SD	N	M	SD	N	M	SD	df	*F*
I/Teachers in my school utilize technology to present material in a way that actively engages students in their learning.	109	3.39	0.74	101	3.24	0.79	464	3.14	0.82	2	4.30**

Note. $^*p<.05$, $^{**}p<.01$, $^{***}p<.001$

Table 57 summarizes respondents' perceptions about the utilization of technology to present material in ways that actively engage students in their learning. Analysis is based on respondents' categorization as general education or special education, as well as their level of UDL training. General educators and special educators with training in UDL indicated the highest frequency which fell in the "Often" category (M = 3.34 and 3.23 respectively). General educators and special educators with no training reported lower frequency (M = 3.15 and 3.09 respectively). Kruskal-Wallis non-parametric analysis identified a statistically significant difference in respondent groups' mean ranks ($\chi2 = 8.11$, df 3, $p<.05$). Based on mean ranks, both respondent groups trained in UDL reported higher frequency than did respondent groups with no training in UDL.

Table 57

General Education/Special Education Perceptions of Technology Use to Present Material in a Way That Actively Engages Students in Their Learning

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Gen Ed (UDL)	162	3.34	0.76	370.23		
Sp Ed (UDL)	48	3.23	0.81	345.43	3	8.11*
Gen Ed (no UDL)	395	3.15	0.83	328.01		
Sp Ed (no UDL)	69	3.09	0.78	309.47		
Total	674	3.19	0.81			

Note. **p* <.05, ***p* <.01, ****p*<. 001

Table 58 summarizes respondents' perceptions about the utilization of technology to present material in ways that actively engage students in their learning. Analysis is based on respondents' categorization as administrators and teachers, as well as their level of UDL training. All respondent groups reported frequency of use within the "Often (1-2 times/week)" category. Teachers trained in UDL indicated the highest frequency (M = 3.36), while the other respondent groups reported similar frequency of use (AdUDL = 3.17; AdNoUDL = 3.17; TchNoUDL = 3.14). Kruskal-Wallis test which found a significant difference between groups ($\chi 2 = 9.38$, df 3, $p<.05$). Teachers trained in UDL reported the highest frequency supported by mean ranks in technology use to present material to actively engage student in their learning.

Table 58

Administrator/Teacher Perceptions that Technology is Used to Present Material to Actively Engage Students in Their Learning

Respondents	N	Mean	Std. Dev.	Kruskal-Wallis Test Mean Rank	df	χ^2
Admin (UDL)	48	3.17	0.78	327.78		
Teacher (UDL)	162	3.36	0.76	375.46	3	9.38*
Admin (no UDL)	23	3.17	0.78	328.78		
Teacher (no UDL)	441	3.14	0.82	325.07		
Total	674	3.19	0.81			

Note. *p <.05, **p <.01, ***p<. 001

Summary

Results of these analyses suggest that there are differences in perceptions of students' level of engagement in classroom activities based on faculty level of training in UDL principles. Both respondent groups trained in UDL indicated stronger agreement that students having more choice in their instruction and assessment leads to more engagement in the material being presented. There were also significant differences in respondents' perceptions that technology is utilized to present material in a way that actively engages students in their learning. Specifically, statistical difference was found in comparisons of those who completed UDL training and those with no UDL training.

Analyses based on respondents' categorization as general education or special education was also completed. In addition, further analyses were completed based on categorization as administrator or teacher. Several areas of significant difference were identified between general education and special education respondents based on their participation in UDL training, including the impact of student choice in instruction and assessment, as well as technology use to present material in a way that actively engages students in learning. Significant differences were found between administrator and teacher respondents in the impact of student choice in instruction and assessment on level of engagement, as well as technology use to present material to actively engage students in their learning.

Research question 4

What factors are identified by school faculty that positively impact the use of technology to accommodate the needs of diverse learners?

Table 59 summarizes factors that positively impact the use of technology to accommodate diverse learners in schools. Respondents rated the importance of 11 factors on a scale from 0 to 100 on the following scale: 1 – Not Important (0-25); 2 – Somewhat Important (26-50); 3 – Important (51-75); 4 – Very Important (76-100). All variables among the three respondent groups had means within the range categorized as "Important" or "Very Important" (means ranged from 2.78 to 3.82).

Table 59

Factors that Positively Impact the Use of Technology Based on Level of UDL Training

	UDL - Completed			UDL - Current			No UDL		
Question	N	M	SD	N	M	SD	N	M	SD
A school-wide technology plan with clear expectations for teachers and students.	113	3.37	0.72	101	3.51	0.67	465	3.15	0.78
A principal that models the use of technology in daily school activities.	114	3.27	0.79	101	3.23	0.82	467	2.99	0.85
Encouragement from the principal to utilize technology within the classroom.	114	3.58	0.65	101	3.61	0.58	470	3.19	0.79
Professional development focusing on utilizing technology to accommodate diverse students.	113	3.70	0.52	100	3.76	0.51	468	3.47	0.72
Collaboration with other teachers, technology personnel, and administrators.	112	3.73	0.50	97	3.71	0.58	468	3.54	0.63
Recognition from the principal when utilizing technology in the classroom.	113	3.06	0.84	101	3.03	0.93	468	2.78	0.93
Involvement in administrative decisions about technology, uses, functions, and locations.	113	3.38	0.70	101	3.43	0.70	466	3.18	0.81
Time to investigate and explore technology options.	113	3.66	0.54	101	3.72	0.53	468	3.56	0.69
Access to appropriate technology supports when needed.	114	3.75	0.48	100	3.79	0.46	467	3.68	0.59
Technology support for infrastructure and networking issues that foster technology use in the classroom.	112	3.76	0.51	100	3.70	0.61	464	3.57	0.64
Funding for technology use.	112	3.82	0.47	100	3.78	0.58	462	3.74	0.56

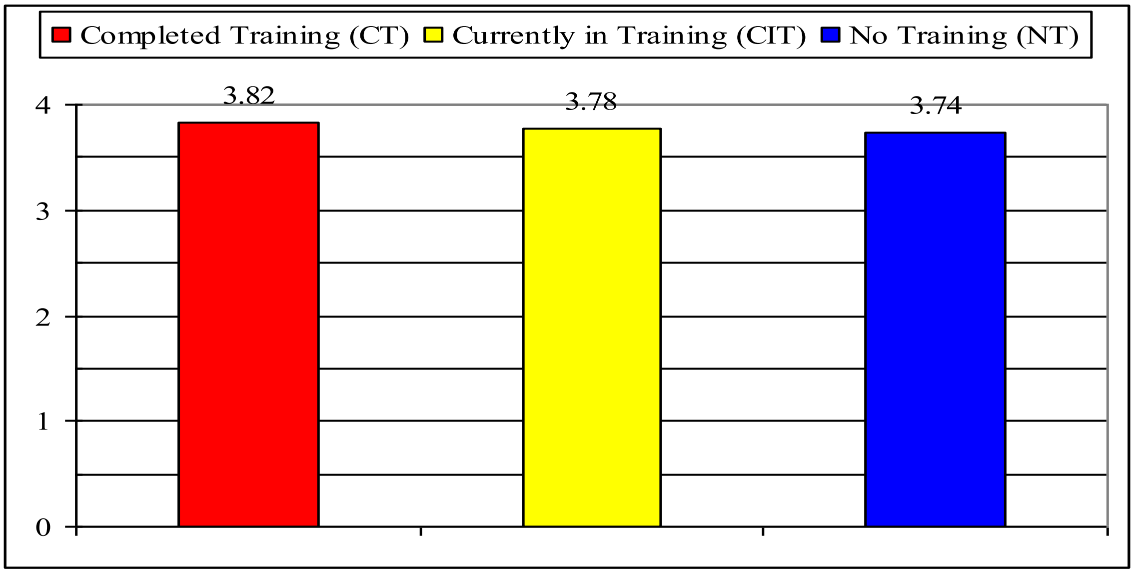
Specific Factors Impacting Technology Integration

In responding to the importance of funding to technology integration, 17 respondents (2.4%) indicated “Do Not Know” or did not answer the question. All respondents’ group means placed funding in the “Very Important” category. Respondents who had completed UDL training and those with no UDL training indicated funding as the most important factor impacting technology integration (M = 3.82 and 3.78

respectively). Those respondents currently in training indicate funding as the second most important factor (M = 3.78). Figure 1 provides a visual representation of the respondent groups' means on the level of importance of funding for technology use.

Figure 1

Importance of Funding on Technology Integration Based on Respondents' Level of UDL Training

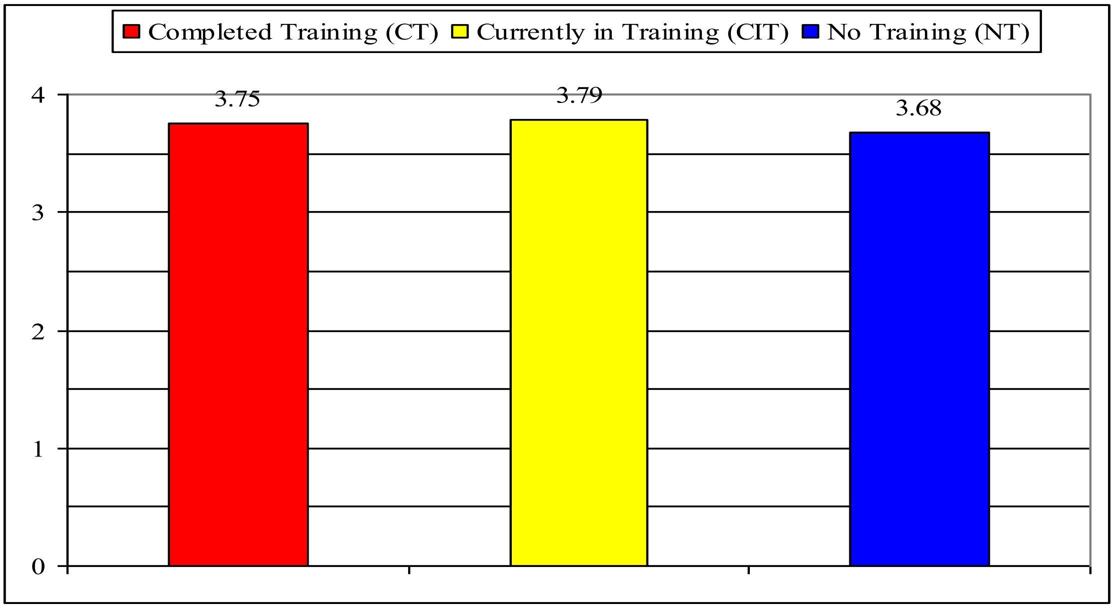


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents also reported on the importance of having access to appropriate technology supports when needed. Ten respondents (1.4%) indicated "Do Not Know" or did not answer the question. All respondent groups indicated this variable was within the "Very Important" category. Respondents currently in UDL training indicated that access to technology supports was the most important factor (M = 3.79), while those with no UDL training indicated it as the second most important factor (M = 3.68). Respondents who have completed UDL training indicated access as the third most important factor (M = 3.75). Figure 2 provides a visual representation of the respondent groups' means on the level of importance of access to appropriate technology supports when needed.

Figure 2

Importance of Access to Appropriate Technology Supports on Technology Integration Based on Respondents' Level of UDL Training

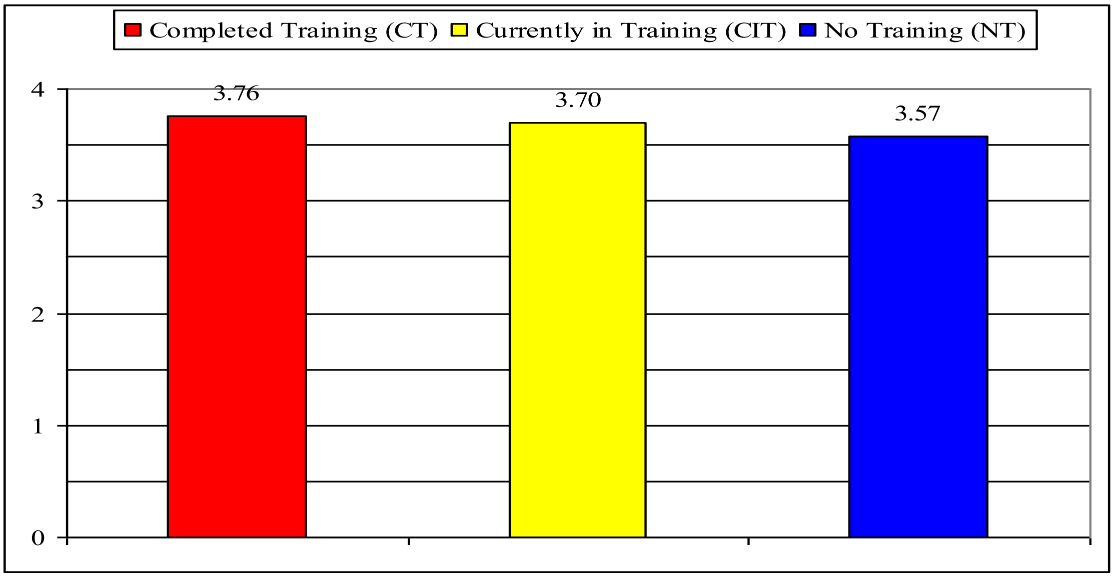


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Analysis was completed examining the importance of technology support for infrastructure and networking issues that foster technology use in the classroom. Fifteen respondents (2.2%) indicated "Do Not Know" or did not answer the question. All respondents indicated that technology support for infrastructure and networking issues tended toward the "Very Important" range (CT = 3.76; CIT = 3.70; NT = 3.57). The mean responses for this variable were second highest for the group of respondents who have completed UDL training and third highest for those with no UDL training. Figure 3 provides a visual representation of the mean responses for each level of UDL training on the importance of technology support for infrastructure and networking issues in fostering technology integration in the classroom.

Figure 3

Importance of Technology Support on Technology Integration Based on Respondents' Level of UDL Training

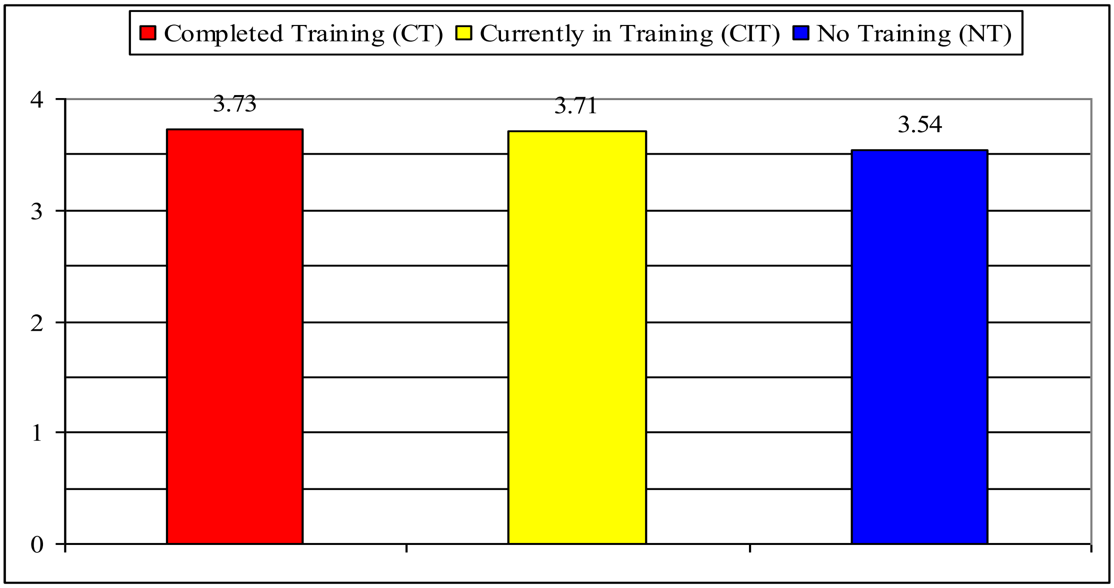


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

When indicating the importance of collaboration with other teachers, technology personnel, and administrators, 14 respondents (2.0%) indicated "Do Not Know" or did not answer the question. All respondent groups reported their perceived level of importance of collaboration as "Very Important" in their technology integration. This variable had mean responses placing it fourth in importance for those respondents who completed training (M = 3.73), and fifth in importance for those currently in training and those with no UDL training (M = 3.71 and 3.54 respectively). Figure 4 provides a visual representation of the mean responses for each level of UDL training on the importance of collaboration in fostering technology integration in the classroom.

Figure 4

Importance of Collaboration with Other Faculty on Technology Integration Based on Respondents' Level of UDL Training

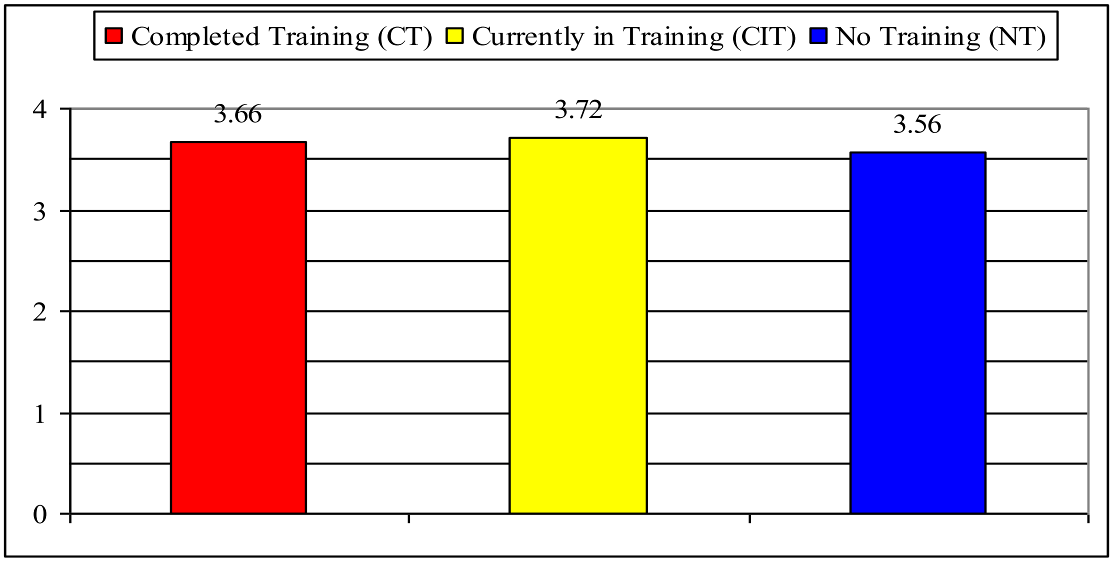


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents were asked to indicate the importance of time to investigate and explore technology options. Nine respondents (1.3%) indicated "Do Not Know" or did not answer the question. All respondent groups rated the level of importance of time to investigate and explore technology options as tending toward "Very Important" in their technology integration. This variable had mean responses placing it sixth in importance for those respondents who completed training (M = 3.66), and fifth in importance for those currently in training and those with no UDL training (M = 3.72 and 3.56 respectively). Figure 5 provides a visual representation of the mean group responses for each level of UDL training on the importance of time in fostering technology integration in the classroom.

Figure 5

Importance of Time to Investigate and Explore Technology Options on Technology Integration Based on Respondents' Level of UDL Training

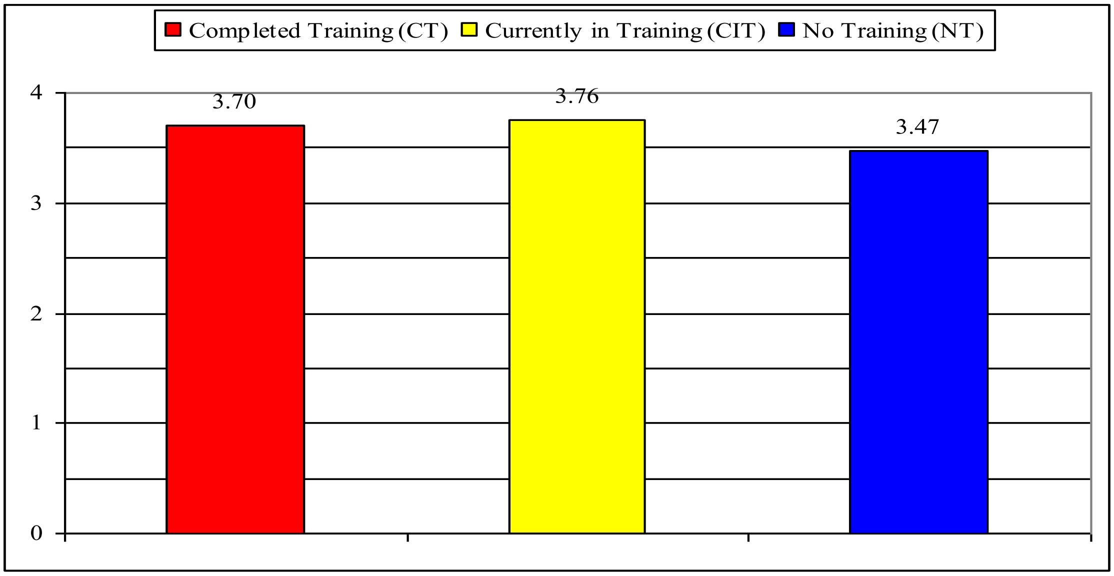


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents rated the level of importance of professional development focusing on utilizing technology to accommodate diverse students in their technology integration. Ten respondents (1.5%) indicated "Do Not Know" or did not answer the question. CT and CIT respondent groups rated professional development as tending toward "Very Important," while NT respondent groups rated professional development as "Important." This variable had mean responses placing it fifth in importance for those respondents who completed training (M = 3.70), third in importance for those currently in training (M = 3.76), and sixth in importance for those with no UDL training (M = 3.47). Figure 6 provides a visual representation of the means for each level of UDL training on the importance of professional development in fostering technology integration in the classroom.

Figure 6

Importance of Professional Development on Technology Integration Based on Respondents' Level of UDL Training

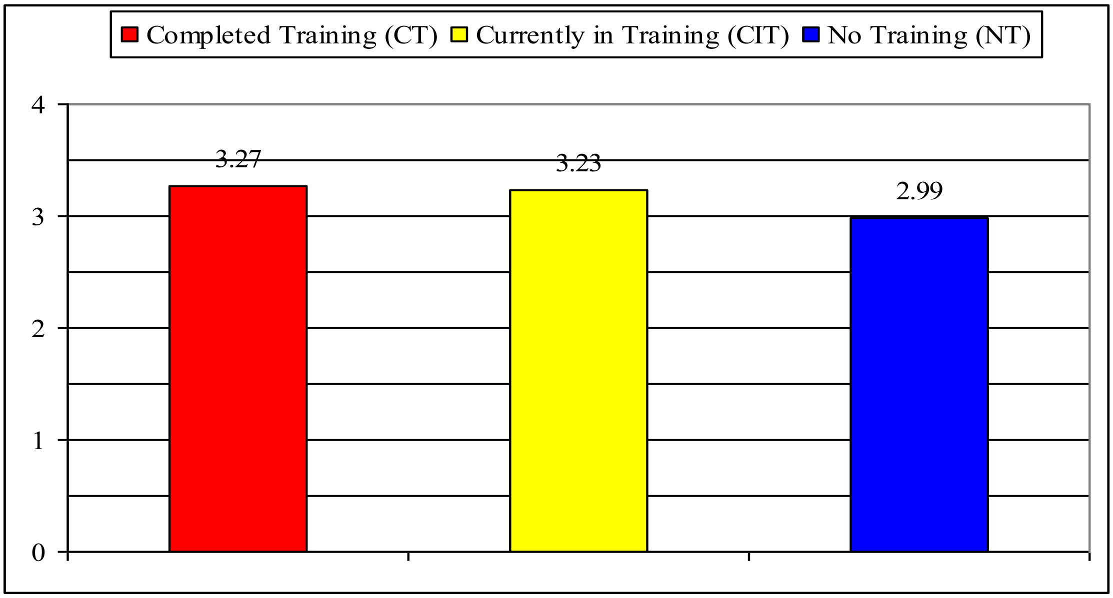


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents also reported on several variables relating to the level of importance of administrators in their technology integration. When examining the importance of a principal that models the use of technology in daily school activities, nine respondents (1.3%) indicated "Do Not Know" or did not answer the question. All respondent groups reported this variable as the tenth most important and within or tending toward the "Important" range (CT = 3.27; CIT = 3.23; NT = 2.99). Figure 7 provides a visual representation of the means for each level of UDL training on the importance of a principal modeling technology in daily school activities in fostering technology integration in the classroom.

Figure 7

Importance of a Principal that Models Technology Use on Technology Integration Based on Respondents' Level of UDL Training

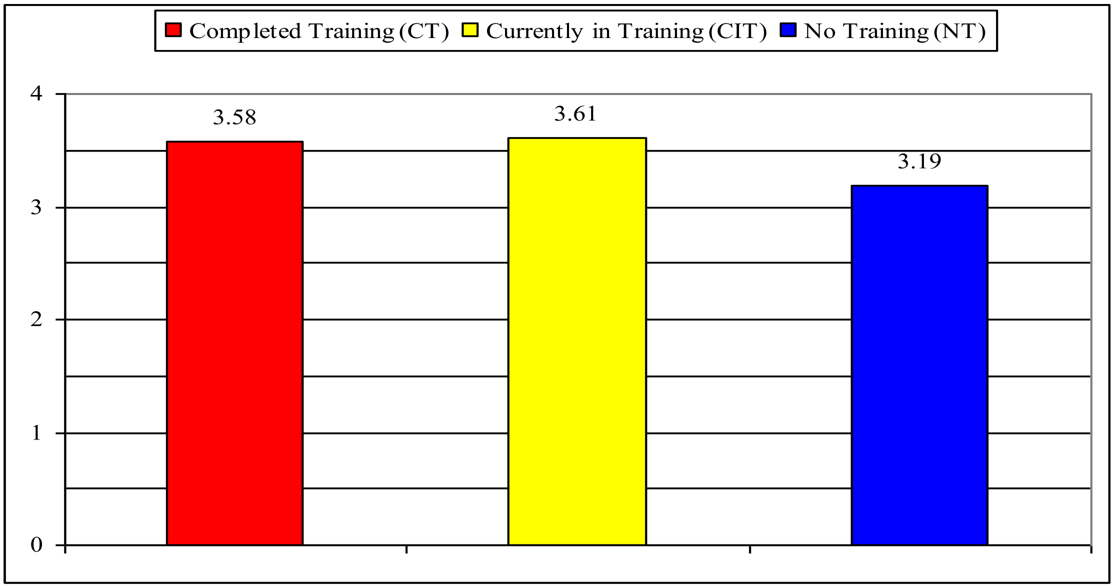


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

When examining the importance of encouragement from the principal to utilize technology within classrooms, six respondents (0.9%) indicated "Do Not Know" or did not answer the question. All respondent groups had mean group responses placing that variable as the seventh most important. CT and CIT respondents reported strong importance that tended toward the "Very Important" range (M = 3.58 and 3.61 respectively), while NT group responses fell in the "Important" range (NT = 3.19). Figure 8 provides a visual representation of the means for each level of UDL training on the importance of encouragement from the principal on fostering technology integration in the classroom.

Figure 8

Importance of Encouragement from the Principal on Technology Integration Based on Respondents' Level of UDL Training

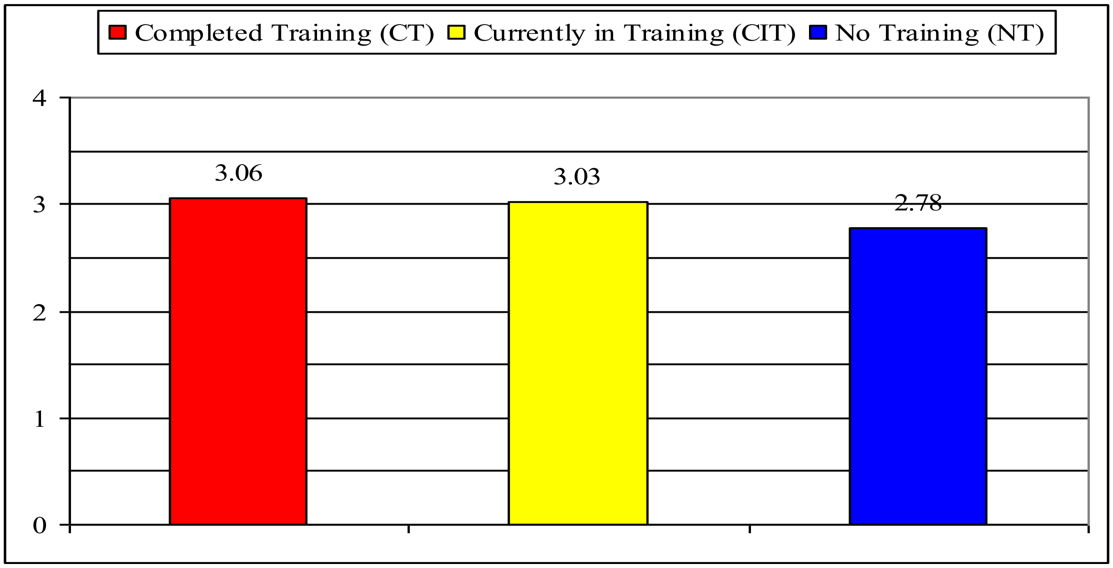


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

When examining the importance of recognition from the principal when utilizing technology in the classroom, nine respondents (1.3%) indicated "Do Not Know" or did not answer the question. All respondent groups indicated principal recognition was the least important of all variables, but still within or tending toward the "Important" category (CT = 3.06; CIT = 3.03; NT = 2.78). Figure 9 provides a visual representation of the means for each level of UDL training on the importance of recognition from the principal on fostering technology integration in the classroom.

Figure 9

Importance of Recognition from the Principal on Technology Integration Based on Respondents' Level of UDL Training

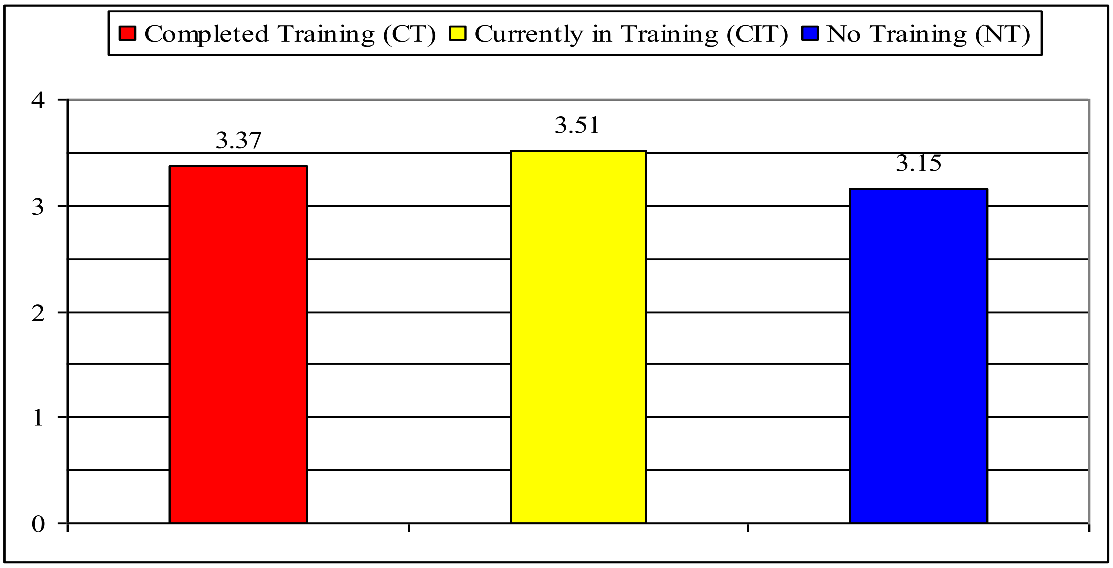


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents were asked to indicate the importance of a school-wide technology plan with clear expectations for teachers and students on their technology integration. Twelve respondents (1.7%) indicated "Do Not Know" or did not answer the question. Those respondents currently in UDL training had mean group responses placing this variable as the eighth most important and tending toward the "Very Important" category (M = 3.51). Respondents who had completed UDL training and those with no UDL training had mean group responses placing this variable as the ninth most important and in the "Important" range (M = 3.37 and 3.15 respectively). Figure 10 provides a visual representation of the means for each level of UDL training on the importance of a school-wide technology plan on fostering technology integration in the classroom.

Figure 10

Importance of a School-wide Technology Plan on Technology Integration Based on Respondents' Level of UDL Training

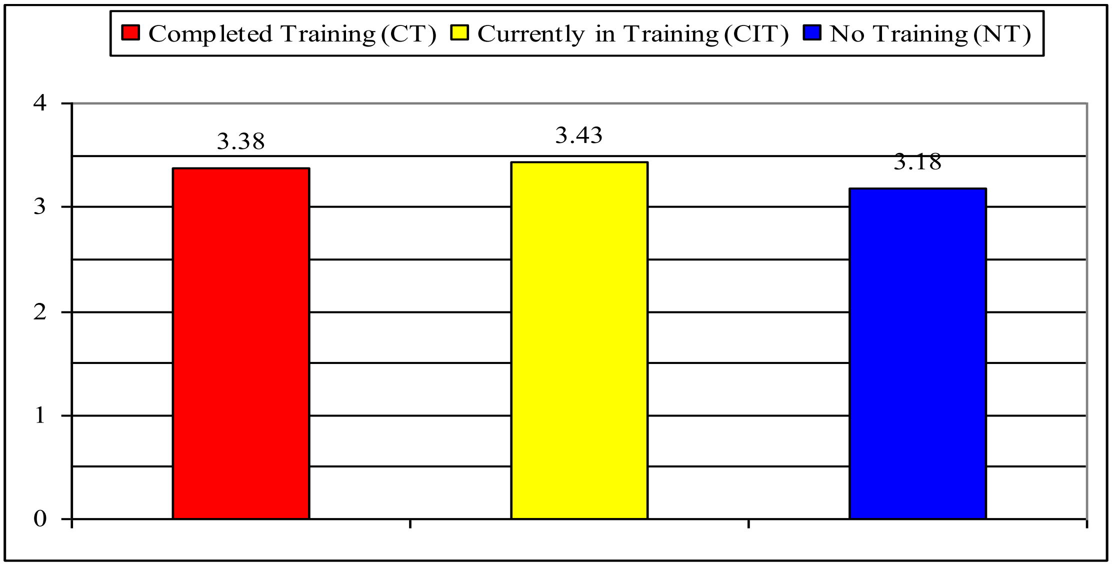


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Respondents indicated the importance of their involvement in administrative decisions about technology, uses, functions, and locations on their technology integration. Eleven respondents (1.6%) indicated "Do Not Know" or did not answer the question. Those respondents who have completed UDL training and those with no UDL training had mean group responses placing this variable as the eighth most important and in the "Important" category (M = 3.38 and 3.18 respectively). Respondents who are currently in UDL training had mean group responses placing this variable as the ninth most important and also in the "Important" category (M = 3.43). Figure 11 provides a visual representation of the means for each level of UDL training on the importance of involvement in decisions on fostering technology integration in the classroom.

Figure 11

Importance of Involvement in Administrative Decisions on Technology Integration Based on Respondents' Level of UDL Training



Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

All three respondent groups identified funding as a significant factor in technology integration. Funding had the highest mean of all responses from two of the three respondent groups (CT and NT respondents). In the third group (CIT respondents), funding had the second highest mean. Access to appropriate technology supports was another factor that received high mean responses from all three groups. Access to appropriate technology supports had the highest mean response from those respondents currently in UDL training, the second highest mean response from those with no UDL training, and the third highest mean response from those who had completed UDL training.

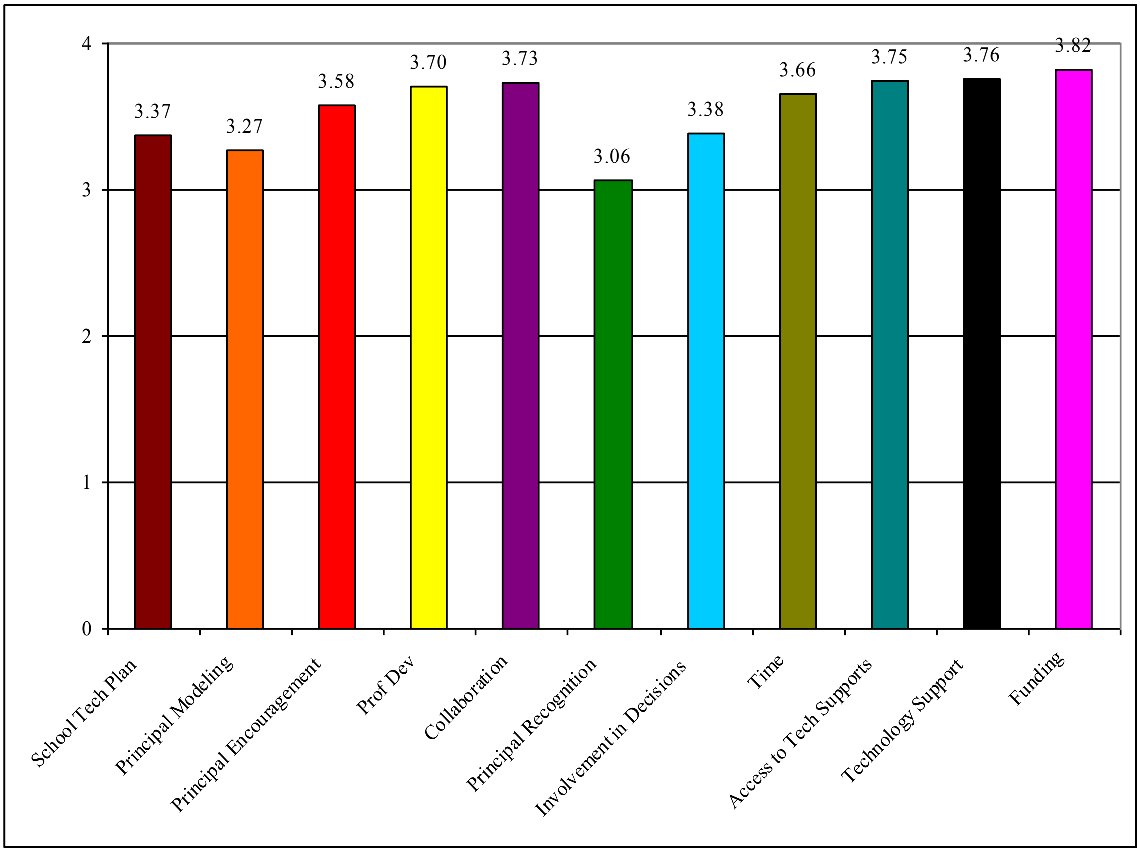
While all respondent groups' mean responses fell at or above the "Important" category, it is valuable to look at patterns in the factors that had the lowest means. The same four factors were identified by all three respondent groups as having the lowest importance on technology integration. Involvement in administrative decisions about technology, uses, functions, and locations, as well as a school-wide technology plan with clear expectations for teachers and students had the third and fourth lowest means of all factors from all three respondent groups. The two factors that were ranked with the lowest means across all respondents were a principal that models the use of technology in daily school activities and recognition from the principal when utilizing technology within the classroom.

Factors Impacting Technology Integration Based on UDL Training

Figure 12 provide a visual representation of those respondents who had completed UDL training and their perceptions of the importance of factors leading to technology integration. CT respondents indicated funding was the most important factor in technology integration (M = 3.82), while recognition from the principal was rated as the least important factor (M = 3.06). The following factors tended toward “Very Important”: funding, technology support, access to technology, time, collaboration, professional development, and encouragement from the principal. All other factors, including involvement in administrative decisions about technology, recognition from the principal, modeling of technology use by the principal, and a school technology plan were rated as “Important” factors in technology integration.

Figure 12

Factors Leading to Technology Integration by Respondents Who Have Completed UDL Training (CT)

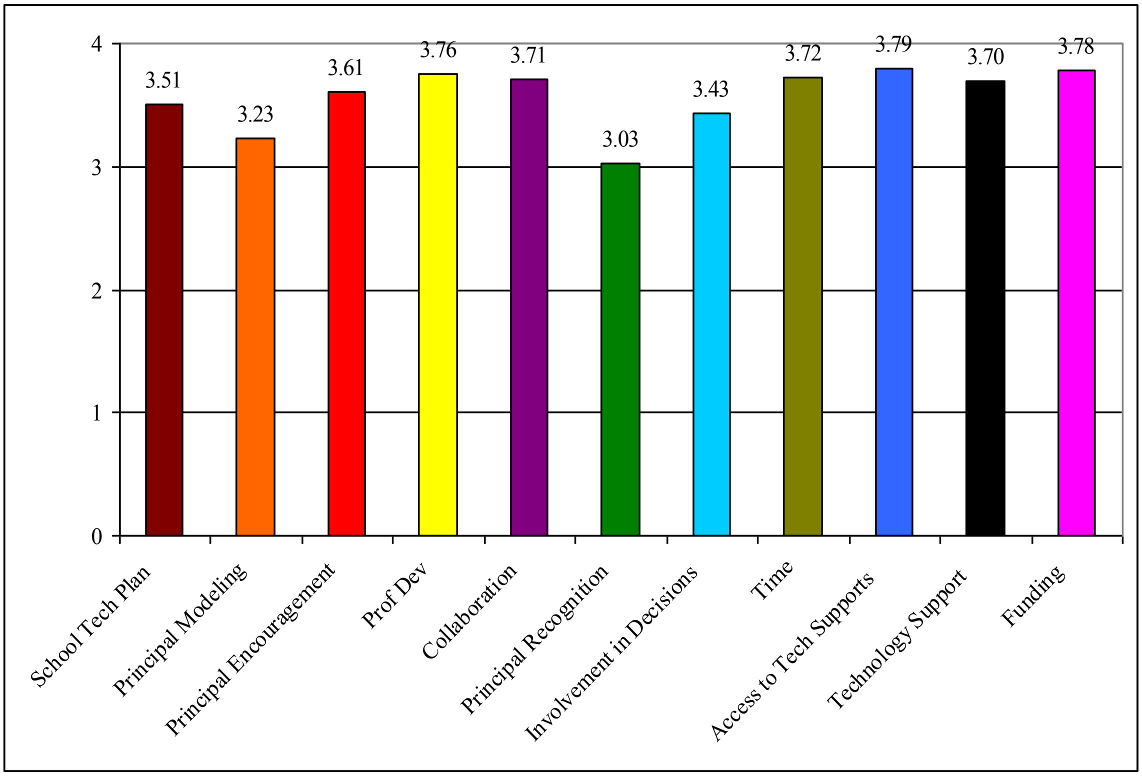


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Figure 13 provides a visual representation of those respondents who are currently in UDL training and their perceptions of the importance of factors leading to technology integration. CIT respondents indicated the most important factors in technology integration in classrooms were access to technology supports when needed (M = 3.79), funding (M = 3.78), and professional development (M = 3.76). Other factors, including technology support, time, collaboration, encouragement from the principal, and a school technology plan tended toward "Very Important." Recognition from the principal was reported as the least important factor influencing technology integration though it was within the “Important” category (M = 3.03). Other factors that fell within the “Important” category were involvement in administrative decisions about technology and the principal modeling technology use.

Figure 13

Factors Leading to Technology Integration by Respondents Who Are Currently Participating in UDL Training (CIT)

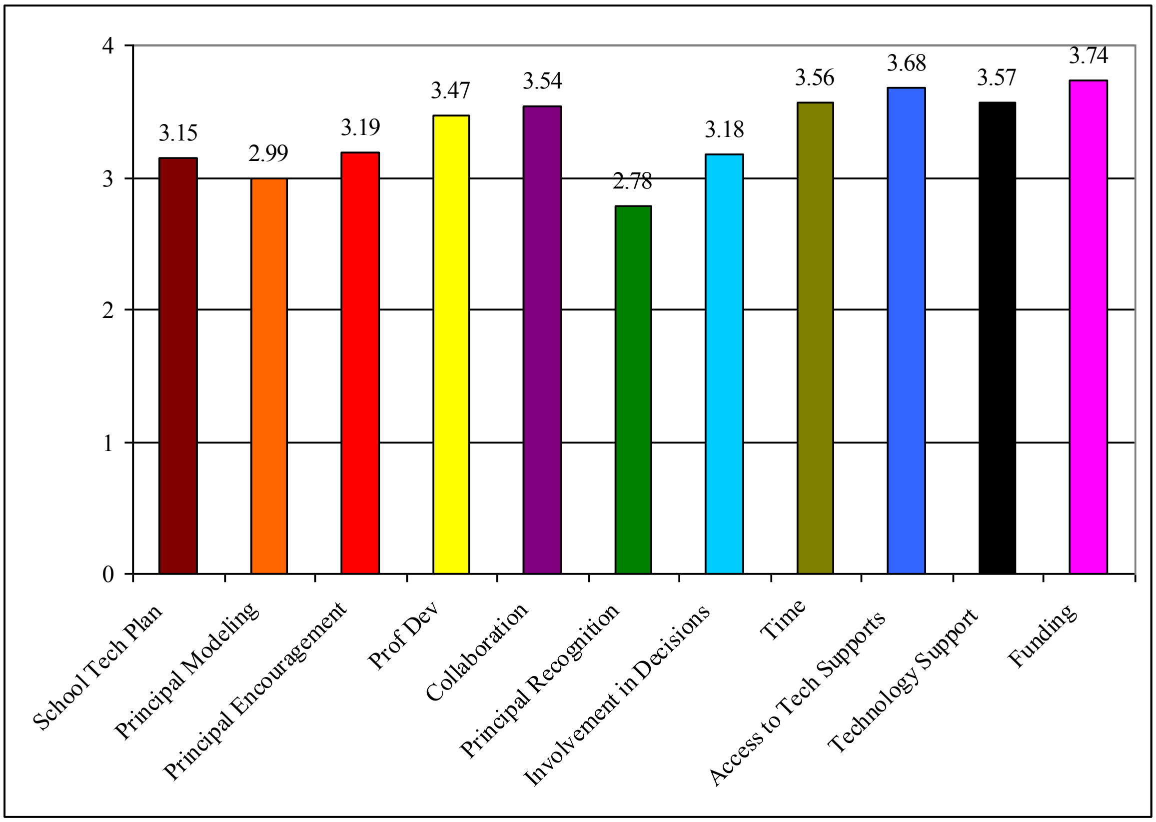


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Figure 14 provides a visual representation of those respondents who have not participated in UDL training and their perceptions of the importance of factors leading to technology integration. NT respondents reported the most important factors in technology integration were funding (M = 3.74) and access to technology supports when needed (M = 3.68). The following other factors tended toward “Very Important”: technology support, time, and collaboration. NT respondents indicated that recognition from the principal when using technology was the least important factor though it still tended toward “Important” (M = 2.78). Other factors that tended toward or were within the “Important” range included involvement in administrative decisions about technology, encouragement from the principal, principal modeling technology use, and a school technology plan.

Figure 14

Factors Leading to Technology Integration by Respondents With No Participation in UDL Training (NT)

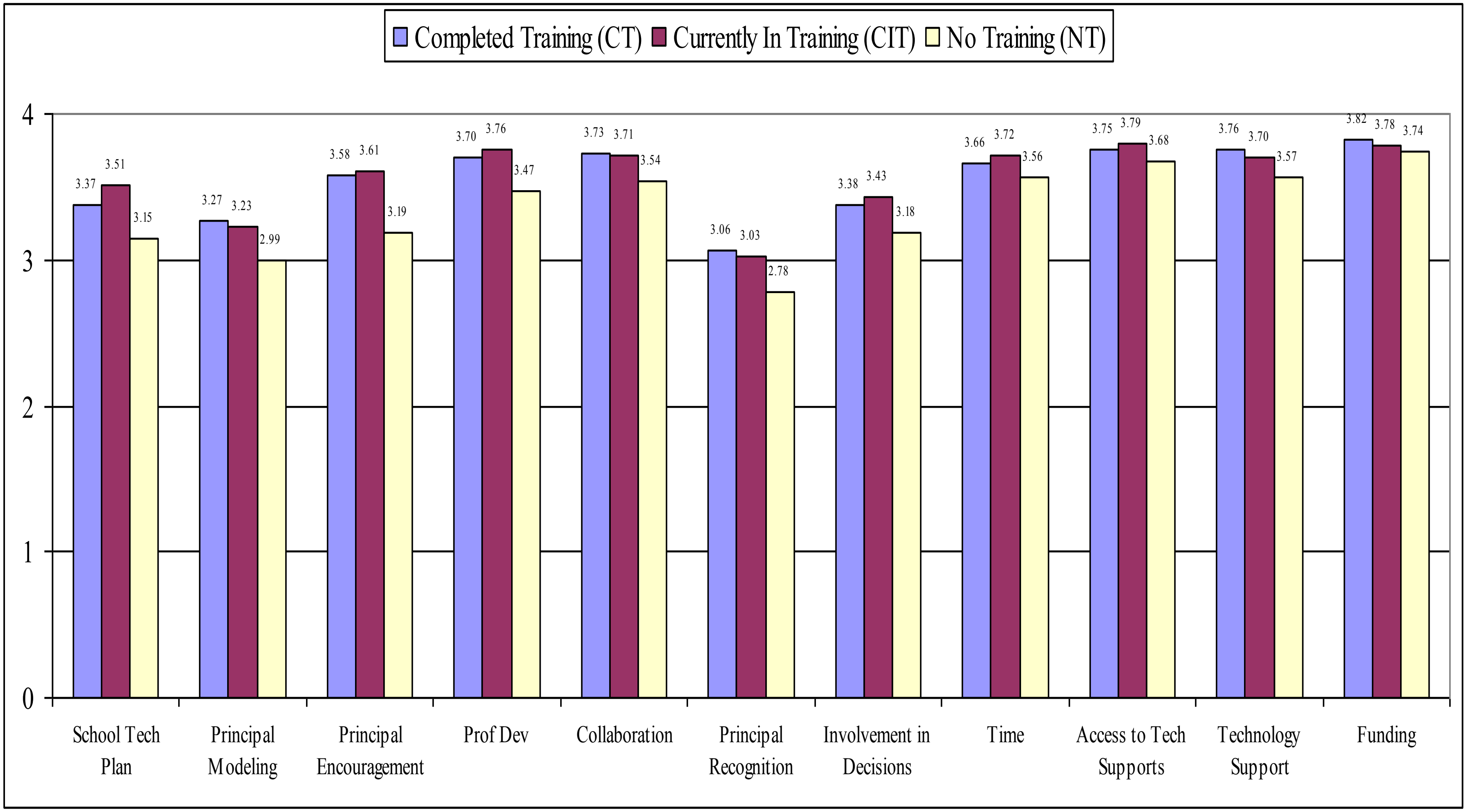


Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Figure 15 provides a visual representation of the means for each respondent group in regards to their perceived importance for each of the factors in technology integration.

Figure 15

Importance of Factors Leading to Technology Integration Based on Respondents' Level of UDL Training



Note. Likert-type Scale: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important

Among the respondent groups several factors were recognized as positively impacting technology integration. Funding and access to technology supports when needed were reported in the top three factors for all respondent groups. Technology support for infrastructure and networking issues was reported in the top three factors among both CT and NT respondents. Similarly, there was consistency in which factors were lowest in terms of importance among the three groups. A school-wide technology plan, involvement in administrative decisions about technology, a principal that models technology use, and recognition from the principal when using technology were rated as the four lowest factors impacting technology integration among all three respondent groups.

Table 60 summarizes responses to an open-ended survey question regarding additional factors that impacted faculty's ability to utilize technology with diverse students. Responding to this open-ended question was not required for survey completion. Of all respondents, 146 teachers and 16 administrators responded to this question. Responses were analyzed based on whether they had participated in UDL training (CT or CIT) or had not participated in UDL training. Each comment was coded by the researcher and categorized into central themes. In some cases, a comment addressed multiple themes and was categorized in all themes which it addressed.

Table 60 displays that most comments made by respondents were elaborations on choices presented in the Likert-type survey questions previously discussed. Both respondents trained in UDL and those with no training in UDL had more comments on access to technology supports than any other central theme (27.1% and 31.7% respectively). Respondents reported access issues such as scheduling, availability of computer labs, the need for new computer programs, lack of computers in schools, and technology resources not being shared equitably among staff. Another example of respondents' elaboration on factors discussed earlier was time. Time was the subject of 18.6% of comments from faculty trained in UDL and 9.4% of comments from faculty with no training in UDL. Comments included the need for more time to collaborate, plan, practice, and explore technology options. Technology support was another area in which respondents elaborated on a factor discussed earlier with 8.5% of comments from UDL trained faculty and 14.4% of comments from faculty not trained in UDL pertaining to technology support. Issues included in this category include concerns with technology issues, server problems, security issues which limit student and teacher access, and having issues resolved and programs installed and updated from technology personnel in a timely manner.

Other comments elaborated on the importance of professional development with 11.9% of comments from faculty trained in UDL and 7.9% of comments from faculty with no training in UDL pertaining to this theme. Comments referenced the importance of ongoing training that goes beyond a one-time workshop and includes multiple opportunities for practice, exploration, and application. Other respondents elaborated on the importance of funding (UDL = 3.4%; NoUDL=5%) and collaboration with other personnel including teachers and technology personnel (UDL = 5.1%; NoUDL = 1.4%).

Some comments from respondents highlighted areas that were not included in the Likert-type portion of the survey which addressed factors impacting technology integration. Student factors comprised 5.1% of comments from staff trained in UDL and 10.8% of comments from staff not trained in UDL. These comments included issues such as student ability to use programs, students having access to technology at home, student frustration with technology, developmental appropriateness of technology for younger students, and students not using technology appropriately. Some respondents' comments also indicated that the curriculum limited their ability to use technology (UDL = 5.1%; NoUDL = 4.3%). In some cases, these comments came from special area teachers (art, music, or physical education) or those that use a more formalized curriculum (e.g., English as a New Language and Career Center). Some comments were classified as "Other" (UDL = 15.3%; NoUDL = 10.1%) as they were made by only one or two respondents and could not be classified within another theme. These comments included general comments about the survey, as well as factors such as class size, age of the teacher, teacher motivation to learn new things, a technology plan, modeling of technology use by the principal, the need for more software programs, and the need for data and research supporting technology innovations.

Table 60

Additional Factors Impacting Ability to Utilize Technology with Diverse Students

	UDL		No UDL	
	N	%	N	%
Central Themes				
Technology Support	5	8.5	20	14.4
Involvement in Tech Decisions	0	0	7	5
Access to Technology	16	27.1	44	31.7
Student Factors	3	5.1	15	10.8
Professional Development	7	11.9	11	7.9
Time	11	18.6	13	9.4
Funding	2	3.4	7	5
Collaboration	3	5.1	2	1.4
Curriculum	3	5.1	6	4.3
Other	9	15.3	14	10.1
Total	59	100.1	139	100

Summary of Findings

This study highlighted several areas where training in UDL was found to impact faculty perceptions. Significant differences were found between CT, CIT, and NT respondents in areas related to the inclusion of students with disabilities. Significant differences were found between both respondent groups trained in UDL, as well as those who had completed UDL training and those with no UDL training. A significant difference was also found in perceptions that accommodations designed for students with disabilities usually create increased opportunities for all learners. Specifically, significant differences were found between both respondent groups trained in UDL and those with no training in UDL. Significant differences were also found between general educators and special educators in special education teachers having primary responsibility for providing accommodations for students with disabilities. Analysis of general educators and special educators' perceptions that accommodations usually create increased opportunities for all students found significant differences. Analysis of administrators and teachers' perceptions found a significant difference when examining perceptions that accommodations create increased opportunities for all students with higher agreement being reported from respondent groups trained in UDL.

Analysis was completed that examined specific forms of technology and perceptions of respondents at different levels of UDL training, including currently participating in training, completed training, and no training. Both respondent groups with training in UDL indicated significantly more use of technology for research, software programs to learn new skills, software programs to reinforce concepts previously learned, assessments/tests online, organization, interactive presentation technology, interactive assessments, word processing, drill and practice of specific skills, text-to-speech programs, and mobile technology. CIT respondents reported significantly different frequency of use than NT respondents in homework online, multi-media presentations, and web tools. Analyses that examined respondents' perceptions based on categorization as general education or special education identified several areas where differences existed, including the frequency that technology is used to provide more choice and flexibility to students, to present material in ways that support all students learning, and to allow students to express what they have learned. Analyses examining the frequency of various technology uses identified significant differences between groups in the following areas: word processing, research, drill and practice, software to teach new skills, software to reinforce previously taught skills, assessments/tests online, homework online, and multi-media presentations. Analysis was completed that examined differences between respondents categorized as administrators or teachers and found significant differences among all variables in frequency of use between respondent groups. In all variables for both groups (UDL trained and UDL not trained), administrators reported higher frequency of technology use than did teachers.

Analyses found significant differences in perceptions of students' level of engagement in classroom activities based on faculty level of training in UDL principles. Both respondent groups trained in UDL indicated stronger agreement that students having more choice in their instruction and assessment leads to more engagement in the material being presented. There were also significant differences in respondents' perceptions that technology is utilized to present material in a way that actively engages students in their learning. Specifically, statistical difference was found in comparisons of those who completed UDL training and those with no UDL training. Analyses based on respondents' categorization as general education or special education, as well as administrator or teacher were also completed. Several areas of significant difference were identified between general education and special education respondents based on their participation in UDL training, including the impact of student choice in instruction and assessment, as well as technology use to present material in a way that actively engages students in learning. Significant differences were found between administrator and teacher respondents in the impact of student choice in instruction and assessment on level of engagement, as well as technology use to present material to actively engage students in their learning.

Several factors were recognized as positively impacting technology integration. Funding and access to technology supports when needed were reported in the top three factors for all respondent groups. Technology support for infrastructure and networking issues was reported in the top three factors among both respondents who had completed training and those with no training. Similarly, there was consistency in which factors were lowest in terms of importance among the three groups. A school-wide technology plan, involvement in administrative decisions about technology, a principal that models technology use, and recognition from the principal when using technology were rated as the four lowest factors impacting technology integration among all three respondent groups.

CHAPTER FIVE

Overview, Discussion and Recommendations

Study Overview

This study investigated differences in faculty perceptions based on levels of participation in Universal Design for Learning (UDL) training provided through the PATINS Project and the Indiana Department of Education. Specifically, the purpose of this study was to analyze how training in UDL impacted school personnel's perceptions of inclusion, instruction, student engagement/performance in the classroom, and the use of technology to differentiate instruction to meet the needs of diverse learners. A survey instrument was created and distributed electronically to all faculty members at schools who had sent teams to participate in the PATINS-sponsored UDL training over the last six years. Analysis was completed both of team members from each school that participated in the training, as well as the remaining faculty from each school that did not participate in UDL training.

Four research questions were addressed in this study. These questions investigated the perceptions of faculty based on three levels of training in UDL – completed training (CT), currently in training (CIT), or no participation in training (NT). Subsequent analyses were completed that examined respondents based on their categorization as general education or special education. Similar analyses were also completed based on respondents' categorization as administrator or teacher. For the purposes of these analyses, CT and CIT respondents were combined and considered UDL trained. Their responses were compared against NT respondents with no training in UDL.

Sample and Returns

An electronic survey was developed in order to elicit perceptions of school faculty. The survey was designed, housed, and distributed electronically using the inQsit program provided by Ball State University. All faculty members at each participating school were surveyed, including all teachers and administrators. The core content of the survey questions distributed to teachers and administrators was the same, but was presented in a manner that accounted for the different perspectives which respondents represented.

Initial contact regarding survey distribution was directed toward building principals. Once permission to email staff was obtained from the principal, the survey was distributed via email to 2,466 faculty members representing 50 schools and 33 school districts in Indiana. Each email contained a link that directed participants to the online survey. Survey links contained a seven-digit code which allowed the researcher to monitor survey completion and ensure that follow-up emails were directed only to those participants who had not yet completed the survey.

The study involved an eight-week survey period with four iterations of two-week follow-ups. Two weeks after the initial email, follow-up emails were sent to those individuals who had not yet completed the survey. Two weeks later, a third email was sent to those that had not participated. Finally, six weeks from the initial contact with potential participants, a final email was sent to solicit participation. The follow-up email listing was updated after each two-week cycle to ensure that completed respondents did not receive additional emails. Of the 2,466 surveys that were distributed, 691 valid surveys were completed (return rate of 28%). The information gathered in the surveys was analyzed using descriptive statistical methods produced by Statistical Packages for Social Sciences software (SPSS 17.0). ANOVA models, Welch tests, Kruskal-Wallis, Bonferroni tests, and Tamhane tests, as well as means and standard deviations were used to analyze differences among respondent groups' perceptions. Qualitative analysis was completed which examined additional factors indicated by respondents that contributed to their technology integration.

Highlighted Study Findings

Inclusion

The data from this study's findings suggested that there was a difference between those respondents who had completed participation in UDL training, those currently in UDL training, and those with no UDL training. Significant differences were found between respondent groups in their perception that the primary responsibility for accommodating classroom activities for students with disabilities lies with the special education teacher. Respondents currently participating in training indicated the lowest level of agreement falling within the "Disagree" category. Respondents who had completed UDL training and those with no UDL training reported levels of agreement that were higher, but still tended toward "Disagree." Further analyses examining perceptions based on categorization as general education or special education found that special educators trained in UDL reported the highest level of agreement tending toward "Agree," while general educators (both with UDL training and without) reported the lowest level of agreement that tended toward "Disagree." This data suggests general educators largely disagreed that the primary role for accommodation lies with the special education teacher regardless of whether they had participated in UDL training or not.

Students with disabilities require teachers who can implement accommodations and adaptations to overcome the barriers within their instruction and assessments (Stahl, 2006). For students with disabilities, this responsibility has typically fallen on the student's teacher of record who holds certification in their area of disability. The results of this study suggest that even for those special educators trained in UDL, there is less agreement with that responsibility lying anywhere other than the special education teacher.

A statistically significant difference was found between respondent groups in the assertion that accommodations designed for students with disabilities usually create increased opportunities for all learners. Both respondent groups trained in UDL reported significantly higher levels of agreement than respondents with no UDL training. Analysis based on categorization as general education or special education identified significant differences in mean ranks with general educators with no training in UDL reporting the lowest agreement that tended toward "Agree." All other respondent groups indicated higher agreement within the "Agree" range or tending toward "Strongly Agree." General educators trained in UDL indicated agreement that was .5 higher than general educators with no UDL training. When examining respondents' mean ranks based on their categorization as administrators or teachers, a significant difference was found in the perception that accommodations designed for students with disabilities create increased opportunities for all students. Teachers not trained in UDL reported the lowest level of agreement though still tending toward "Agree." These results suggest that UDL training impacted how educators viewed accommodations and their impact on all learners.

Specifically for general educators, UDL training influenced how they viewed the impact accommodations can have on all students.

Technology Use and UDL Philosophies in Classrooms

A comparison of perceptions based on three groups of UDL training (CT, CIT, and NT) found significant differences in the utilization of technology to provide students with more choice and flexibility in completing assignments. However, all respondent groups indicated levels of agreement within the “Agree” range. Analyses based on respondents’ classification as administrator or teacher identified significant differences in perceptions of technology use to provide more choice and flexibility in assignments. However, all respondent groups indicated frequency tending toward or within the lower levels of the “Agree” range.

An examination of the use of technology to present material in ways that support all students learning found respondents who had completed UDL training reported the highest frequency and was significantly higher than those respondents with no UDL training. Analysis of the frequency with which students are presented with opportunities to express what they have learned using technology yielded significant differences between both groups trained in UDL and those with no UDL training. However, all respondent groups reported frequency that tended toward “Often.” Analyses based on respondents’ classification as general education or special education identified significant differences in this variable with general educators trained in UDL indicating the highest frequency. Among administrators and teachers, those teachers trained in UDL reported higher frequency of technology use for the purpose of presenting material to support all students than teachers not trained in UDL and both groups of administrators.

Respondents trained in UDL reported significantly higher frequency of students having opportunities to express what they have learned using technology compared to respondents with no UDL training. General educators with no training in UDL reported the lowest frequency of technology use for this purpose that fell within the “Sometimes” category, while all other respondent groups indicated frequency that tended toward “Often.” Teachers with no training in UDL reported the lowest frequency within the “Sometimes” category, while all other respondent groups tended toward or were within the “Often” category. These analyses suggest that UDL training impacted technology use for the purpose of student expression among faculty categorized as general education and teachers.

Comparisons of specific ways in which technology was used within classrooms found significant differences between CT, CIT, and NT respondent groups in several variables. When examining technology use for research, respondents currently in UDL training reported the highest frequency tending toward “Often,” while respondents who had completed training and those with no training reported frequency in the “Sometimes” category. Among analysis based on categorization as administrator or teacher, administrators reported more technology use for research than teachers with both groups of administrators reporting frequency tending toward “Often,” while teachers reported frequency in the “Sometimes” category.

Respondents who had completed UDL training reported technology use for software programs to learn new skills tended toward “Often,” while those currently in training and those with no training indicated frequency in the “Sometimes” category. Special educators trained in UDL reported the highest frequency of use tending toward

"Often," while special educators with no UDL training and both groups of general educators indicated frequency of use within the "Sometimes" category. Administrators reported significantly higher frequency as both groups reported frequency in the "Often" category, while teachers reported frequency in the "Sometimes" range.

Respondents who had completed UDL training reported significantly more frequent use of technology for software programs that reinforce concepts and skills previously learned. Respondents who had completed training indicated frequency tending toward "Often," while those currently in training and those with no training reported frequency in the "Sometimes" range. Special educators trained in UDL reported frequency tending toward "Often," while other respondent groups reported frequency in the "Sometimes" category. Both groups of administrators reported higher frequency that tended toward "Often," while both groups of teachers reported less frequent use of technology for this purpose.

Respondents currently in UDL training reported significantly more frequent use of technology for multi-media presentations that tended toward "Often," while other respondent groups indicated frequency of use in the "Sometimes" category. Both groups of administrators reported more frequent use that tended toward "Often." Teachers (both trained in UDL and those with no UDL training) reported frequency within the "Sometimes" range.

Respondents currently in UDL training reported that technology use for the purposes of organization tended toward "Often," while those with no training and those who had completed training reported frequency within the "Sometimes" category. General educators trained in UDL reported frequency that tended toward "Often," while general educators with no training in UDL indicated less frequent use that tended toward "Sometimes." Both groups of administrators reported more frequent use that tended toward "Often," while both groups of teachers reported frequency in the "Sometimes" category.

Significant differences were found in the use of technology for the purposes of interactive presentation with both groups trained in UDL reporting frequency that tended toward "Often," while those with no UDL training reported frequency in the "Sometimes" category. General educators and special educators trained in UDL reported significantly more frequent use that tended toward "Often" than their counterparts with no UDL training which indicated frequency in the "Sometimes" category. Both administrators trained in UDL and those with no training in UDL reported frequency within the "Often" category. Teachers trained in UDL reported frequency that tended toward "Often," while teachers with no UDL training reported frequency tending toward "Sometimes."

Both respondent groups trained in UDL reported significantly more frequent use of technology for the purpose of interactive assessment that tended toward "Sometimes," while respondents with no UDL training reported frequency tending toward "Never." General educators and special educators trained in UDL reported frequency tending toward "Sometimes," while their colleagues with no UDL training reported frequency tending toward "Never." Both groups of administrators, as well as teachers trained in UDL reported frequency within or tending toward "Sometimes," while teachers with no UDL training reported frequency tending toward "Never."

Respondents trained in UDL reported significantly more frequent use of technology for the purpose of word processing that tended toward “Often,” while respondents with no UDL training reported frequency within the “Sometimes” category. Both groups of administrators, as well as teachers trained in UDL reported frequency within or tending toward “Often,” while teachers with no UDL training reported frequency in the “Sometimes” category. Both groups of special educators, as well as general educators trained in UDL, reported frequency within or tending toward “Often.” General educators with no training in UDL reported frequency in the “Sometimes” category.

Respondents trained in UDL (both completed and current) indicated technology use for drill and practice of specific skills that tended toward “Often,” while those with no UDL training indicated frequency in the “Sometimes” category. Both groups of special educators, as well as general educators trained in UDL, reported frequency within or tending toward “Often,” while general educators with no UDL training reported frequency within the “Sometimes” category. Both groups of administrators, as well as teachers trained in UDL, reported frequency within or tending toward “Often,” while teachers with no UDL training reported frequency within the “Sometimes” category.

Both respondent groups trained in UDL indicated the frequency of use for text-to-speech programs tended toward “Sometimes,” while those with no UDL training reported frequency within the “Never” category. Both groups of special educators, as well as general educators trained in UDL, reported frequency within or tending toward “Sometimes,” while general educators with no UDL training reported frequency within the “Never” category. Administrators trained in UDL, as well as those with no training and teachers trained in UDL reported frequency within or tending toward “Sometimes,” while teachers with no UDL training reported frequency within the “Never” category.

Respondents who had completed training in UDL, as well as those currently in training, reported the frequency of mobile technology use tended toward “Sometimes,” while those with no UDL training reported frequency within the “Never” category. General educators and special educators trained in UDL reported frequency that tended toward “Sometimes,” while their colleagues with no training indicated frequency within the “Never” category. Both groups of administrators, as well as teachers trained in UDL reported frequency within or tending toward “Sometimes,” while teachers with no UDL training reported frequency in the “Never” category.

Student Engagement

Significant differences were found between CT respondents, CIT respondents, and NT respondents in perceptions that the more choice students have in their instruction and assessment, the more engaged they will be in the material being presented. Respondents who had completed training or currently in training reported agreement that tended towards “Strongly Agree,” while those with no UDL training indicated agreement within the “Agree” category. Both groups of special educators, as well as general educators trained in UDL, indicated agreement that tended toward “Strongly Agree,” while general educators with no UDL training indicated agreement within the “Agree” category. Administrators and teachers trained in UDL reported agreement tending toward “Strongly Agree,” while their colleagues with no training reported agreement within the “Agree” category.

A significant difference was found in perceptions that technology was used to present material in a way that actively engages students in their learning. However, all respondent groups indicated agreement within the “Agree” category. A significant difference was also found in these variables based on further analyses of respondents’ level of UDL training and their categorization as general education or special education, as well as analyses based on categorization as administrator or teacher. However, each of these respondent groups indicated agreement within the “Agree” category.

Factors Impacting Technology Integration

All three respondent groups (CT, CIT, and NT) identified funding as a significant factor in technology integration. Funding had the highest level of importance in two of the three respondent groups (CT and NT). In the third group (CIT), funding had the second highest level of importance compared to all other variables. Having access to appropriate technology supports was another factor with high importance from all three respondent groups—receiving the highest mean from CIT respondents, the second highest mean from NT respondents, and the third highest mean from CT respondents. Similar consistency in variables was found in variables which respondents perceived as having less importance on technology integration. While still falling in the “Important” category, the following variables were the lowest four variables impacting technology integration among all three respondent groups: involvement in administrative decisions about technology, school-wide technology plan, principal that models use of technology in daily school activities, and recognition from the principal when utilizing technology.

Discussion

Ensuring adequate progress of students with disabilities has been a major focus of legislation in the field of education over the last 10 years. Special education has too often led to a lowering of expectations for students with disabilities (Cortiella, 2007). IDEA (2004) and NCLB (2001) have raised expectations and accountability for all students, while focusing on at-risk subgroups, including those with disabilities. Teachers and administrators are charged with ensuring progress in academic standards, while still protecting and addressing the individual needs of students with disabilities. Students with learning disabilities comprise 46% of all students with disabilities and contribute to the majority of students with special needs that are eligible under a classification that should not preclude them from progressing in grade level standards (U.S. Department of Education, 2009). In order to address the needs of diverse learners, schools are seeking professional development programs and strategies that equip teachers to address the unique needs of their students.

Critical to increasing the academic achievement of students with disabilities is raising expectations and making inclusive practices a staple of schools' improvement efforts (Cortiella & Burnette, 2008). While previous technology waves have failed to change what occurs in classrooms (Gordon, 2009), the technology tools available today provide a range of opportunities for teachers to meet the needs of diverse students within inclusive environments. With a growing research base in differentiated instruction and brain research, Universal Design for Learning (UDL) seeks not to serve as another initiative or educational bandwagon, but rather a framework that encompasses varer ious other initiatives into a common theme of flexibility in order to meet the needs of all learners (Rose & Meyer, 2002). Meyer & Rose (2005) suggested UDL is necessitated by two precipitants of change: the needs of underserved students and the capacities of computers and digital media. Barriers have existed within the curricula that include heavily reliance on standard print (Gordon, 2009) and assessments that are rigid and often unfair in responding to students' differences (Cortiella, 2008). The new media options available allow for an expansion of educational opportunities and supports that overcomes the needs of diverse learners who until now have been forced to struggle in a print-centric school environment (Rose et al., 2005). The results of this study suggest that respondents trained in UDL demonstrated more frequent use of technology and media in various ways to accommodate diverse learners and provide more flexibility within their classrooms compared to respondents with no UDL training.

By reducing the barriers that exist throughout schools, a UDL framework provides students with more accessibility and opportunity for academic success. UDL looks different in each classroom where it is implemented based on the strengths and needs of individual students. UDL is based in neuroscience and brain research and utilizes technology advances to improve instruction, but it is not a technology-only approach. Teachers without the latest technological tools in their classrooms can still embrace and apply a UDL approach (Coyne et al., 2006). This study examined perceptions of inclusion, differentiation of instruction, broad UDL philosophies, and technology integration as all were critical components of the PATINS grant program.

The results of this study highlight several areas where training in UDL led to significant differences in faculty perceptions. This supports previous research indicating that participation in professional development in UDL led to changes in teachers' instruction, ability to customize instruction, and integrate UDL principles into lesson plans (Meo, 2008; Spooner et al., 2007). Dymond et al. (2006) found that upon receiving UDL training and support, a general education teacher had greater ownership in the instruction of students with disabilities while the special education teacher's role became more focused on training, planning, and collaborating. The findings from this study suggest that the impact of UDL professional development was strong for general education and special education faculty. Specifically when looking at comparisons between these respondents, a significant difference was found in 19 out of 22 variables (86%). This finding may be the true power of UDL training. As schools have provided students with disabilities more exposure to the general education curriculum and classroom, the role of the general education teacher in addressing the unique needs of students in their classroom becomes more critical. By nature of their preparation and training, special educators may have a stronger understanding of individual differences and ways to accommodate those differences within classrooms. The findings of this study highlight the importance and impact that UDL training has on general education teachers as they seek to address the diverse needs of the students within their classes.

UDL is a broad framework that focuses on building choice and flexibility into the curriculum for all students (Rose & Meyer, 2002). UDL seeks not only to capitalize on the technological tools available in order to meet this goal, but also focuses on the instructional practices that are used for all students (King-Sears, 2009). Results from this study indicate that respondents trained in UDL responded significantly different than their colleagues with no training in UDL on several variables related to technology use in classrooms. Significant differences were found in technology use to provide choice and flexibility (see Table 13), technology use to present material in ways that support all students learning (see Table 13), and presenting students with multiple opportunities to express what they have learned using technology (see Table 14). However, those same levels of significance were not found in variables that focused more on broader UDL philosophies of choice and flexibility in the curriculum without technology. There were no significant differences in faculty perceptions that material is presented through multiple means to allow for more flexibility in instruction (see Table 13), choices being offered to students in how they are assessed and demonstrate their learning (see Table 13), or students being given choices in how they receive core instruction (see Table 14). Edyburn (2010) suggested that the full potential of UDL cannot be achieved without technology because of its ability to create flexible and adaptable materials. Kleiman (2004) asserted that technology is critical to implementing UDL principles in the classroom. The findings of this study suggest that the use of technology in classrooms was impacted based on participation in UDL training.

When looking at differences in specific technology usage within classrooms (Tables 23 to 52), this study identified that in all variables across both levels of training (UDL and No UDL), administrators reported more technology use within classrooms than did teachers. Post hoc analyses were not completed due to the nonparametric analyses completed based on the small group size of administrators with no training in UDL. However, among respondents with no training in UDL, there was a disparity between administrator and teacher ratings of more than .5 on the 4-point scale in 12 out of 15 variables (80%). For those trained in UDL, a disparity of more than .5 was only evident in 2 out of the 15 variables (13%).

Garland (2009-2010) asserted that administrators play a critical role in supporting teachers in their technology integration. While the results of this study found that variables related to administrators tended toward or fell within the “Important” category, these variables were among the lowest in perceived importance compared to other variables. Among all respondent groups, recognition from the principal was the lowest in importance when compared to other variables. Similarly, a principal that models the use of technology was rated as the second lowest in importance among all three respondent groups. However, respondents indicated that encouragement from the principal to utilize technology was within the “Important” category or tending toward “Very Important.”

Limitations

This study involved surveying faculty who has participated in UDL training over the last six years. In that amount of time, there can be movement and transition among the faculty at schools. Because of the limited number of faculty who had participated in UDL training, wherever possible the researcher attempted to find all individuals that represented teams trained in UDL. Only a small number of teachers (n = 4) and administrators (n = 2) that completed the survey had moved to a different school from the one they were employed at during UDL training. The focus of the survey was on each individual respondent’s perception and analysis based on their level of UDL training. For faculty who have been trained in UDL, continued implementation and integration of UDL principles may be enhanced by support and collaboration with other team members. Similarly, the technology resources which were provided through the PATINS grant would no longer be available to a teacher that had left the school they were at during training. While only a small number of respondents had moved to a different school, the impact of their UDL training may have been diminished by losing the support and collaboration of their UDL team, as well as the technology supports provided during training.

Assessing the perceptions of administrators is critical as they set the focus and accountability for instructional practices within their individual schools. However, the portions of this study that delved into comparisons of teachers and administrators based on level of UDL training should be considered exploratory. There was limited participation among administrators with no training in UDL in this study. The low response rate could be due to various reasons. Those administrators who participated in UDL training likely had a stronger commitment and desire to complete the survey as they had participated in the PATINS training. Administrators who had not participated in the PATINS training may not have been aware their school had a team that had been trained or seen the value of participation in this study. Overall, there was a smaller pool of administrators who were sent the survey than teachers. With increasing demands and responsibilities being placed on school administrators, the time taken to complete the survey may also have been a factor for administrators. While the analyses of administrator perceptions cannot be projected beyond the participants of the study, their responses provide potentially valuable insight into the perceptions of school leaders on UDL implementation.

Technology may have served as a limitation within this study. The online survey tool inQsit was used for data collection. While an Internet-based survey has many advantages, it poses challenges as well. Survey links do not always work properly, schools often have security measures limiting emails from outside the school district, and respondents need to have a familiarity with technology in order to access the survey itself. The user being able to properly open the survey link, answer, and submit data electronically is critical to gain accurate responses, and could be a possible restriction in the study's ability to survey all anticipated users.

A limitation of this study is the size of the respondent groups used for analysis. Respondents who had completed UDL training or currently in UDL training were limited based on those who had participated in the PATINS grant project over the last six years. These respondents represented a team of 4-6 faculty members from each school, while respondents with no UDL training represented all other faculty members. This led to a much greater number of respondents with no UDL training than were included in either the group of respondents who had completed training or the group currently participating in training.

The intent of this study was to examine how a UDL framework impacted classroom instruction. This research included faculty participants who applied to participate in a state-sponsored UDL grant program, as well as faculty from those same schools who did not participate. Sites were located throughout the state and represented various demographics, ethnicities, and socio-economic levels. While UDL frameworks are intended to flexibly meet the needs of diverse students, the results of this study should be generalized with caution. One can assume that school teams who invested time to apply for the UDL program had some preliminary interest in using technology to support learning. Thus, the impact of UDL training may have been influenced by a previous interest in or capability for differentiating instruction and using technology in schools.

Recommendations

The findings of this study indicated that training in UDL impacted faculty perceptions in several different areas. While the focus of this study was on assessing faculty perceptions, the primary focus of NCLB and IDEA is to improve the performance of students with disabilities in their academic achievement and progress toward grade level standards. Edyburn (2010) suggested, “The claim that UDL has been scientifically validated through research cannot be substantiated at this time” (p. 34). While it may be premature to promote UDL as an effective and research-based model of inclusion (McGuire et al., 2006), this study contributes to a growing research base that UDL impacts teachers, curriculum, and instruction. Further research needs to be completed to compare the academic achievement of students whose instruction is delivered in a UDL model and students whose instruction is delivered in a more traditional format. While many educators may believe in the philosophies and framework of UDL, it will not make its way to the forefront of educational discourse until it has a stronger research base supporting its impact on student achievement. Edyburn (2010) suggested research in UDL should examine its impact on at-risk or special needs students in inclusive classrooms, but should also look at the secondary effects that may impact other students within the class. Edyburn (2010) asserted,

> UDL is given to everyone with the understanding that those who need specialized support will use the tools when they need them (i.e., embedded, just-in-time supports). To meet the needs of some, UDL is committed to giving the tools to everyone. (p. 39)

Further research is needed that examines the academic performance of all students, including those with unique learning needs, who have access to the supports provided through a UDL framework.

Teams participating in UDL training through the PATINS Project are required to submit lesson plans at the beginning of the grant cycle, and yearly during years two and three to document their implementation of key UDL principles. Further research would be beneficial that more closely analyzed the lesson plans and instruction of teachers to identify specific ways in which UDL training impacted the instruction delivered to students. Structured classroom observations or rubrics completed through a pre-training/post-training analysis would assist in quantifying the impact that UDL training had on lesson design and delivery. Resources are available to assist in this analysis of classroom instruction, including those available from CAST, as well as other researchers (Sopko, 2008; Abell, 2006). As a part of grant participation, regional PATINS staff should utilize a common format for data collection on UDL implementation during their support and on-site visits. This would assist in increasing accountability as schools implement UDL, as well as providing a format for data-based decision making in addressing the needs of participating schools.

This study highlighted the importance of professional development on UDL philosophies and framework. Professional development focusing on utilizing technology in instruction must be expanded to include pedagogical contexts and how technology ties to the curriculum (Zhao et al., 2002). Professional development in the area of UDL should focus on the essential components of UDL: 1) built-in tools within the curriculum to promote access for diverse learners and 2) flexible presentation of curriculum to meet the needs of individual students (Mason & Orkwis, 2005). While technology use is a viable method to accomplish this differentiation, it is important that faculty understand that technology is just an avenue through which a UDL framework can be implemented. Results of this study indicated that UDL training impacted the perception of technology use to differentiate curriculum. However, no significant differences were found in variables assessing perceptions of the broader UDL philosophies, including more student choice in how they receive core instruction, material presented through multiple means to allow for more flexibility, or students being given choices in how they are assessed and demonstrate their learning. Professional development in UDL must present core principles of flexibility, differentiation, and choice, as well as the use of technology to impact those principles within curriculum, instruction, and assessment.

This study highlighted the importance of gaining the support of general education teachers and administrators in UDL implementation. Given the impact that UDL training had on the perceptions of general education teachers, it is critical that UDL implementation not be simply a special education initiative. Kleiman (2004) asserted that technology use in schools is often peripheral with technology plans being separate from school improvement plans, curriculum reform, professional development, and programming for special education. UDL is a broad framework intended to link instruction with technology to address the unique needs and preferences of each individual student. Relegating UDL to the field of special education minimizes the impact that it could have on all students and their teachers. Many educators and policy makers understand the potential of UDL. However, if it is ever to be implemented on a large scale, it should be defined as a subfield of instructional design (Edyburn, 2010).

UDL provides a framework through which addressing the needs of diverse students can unite various programs and initiatives, including English as a New Language, Special Education, Gifted and Talented, and programs for at-risk students. This uniting of initiatives links UDL with the Response to Intervention (RTI) framework that is being implemented across the country following the passage of IDEA 2004. The current structure of the Indiana Department of Education has fostered this alignment by placing the UDL program within the Effective Assessment and Instruction Grant at the Center for Lifelong Learning with ongoing support provided through the PATINS Project.

This study identified many areas where administrators reported technology use at a level of frequency that was higher than was reported by teachers. If professional development is to be successful and teachers are to meaningfully incorporate differentiation and UDL strategies into their classroom practice, it is important that administrators have an accurate awareness of the level of use and technology integration within their buildings. Given the significant expenditures that schools have placed in technology, the level of disparity between technology use from administrators and teachers is concerning. A rubric on implementation of UDL involving both teacher self-assessment and principal walk-throughs has been developed (Sopko, 2008) and would assist in providing more alignment in teacher and administrator perceptions of adherence to the UDL framework.

This study highlighted that training school teams in UDL principles is an effective method to impact teachers across the state. However, the issue of sustainability over time and the overall impact on the participating schools is unclear. An example of sustainability can be found in Bartholomew Consolidated School Corporation (BCSC).

BCSC had one school that participated in the UDL pilot program in 2003. Since then, the district has adopted UDL principles and is implementing UDL in all 19 schools in the district (CAST, 2009). This type of district-level commitment will lead to sustainability that allows UDL to impact schools and overcome such obstacles as faculty turnover, administrator involvement, and adequate support from general education.

School districts should closely examine whether district adoption of UDL principles may provide a comprehensive professional development focus to address the needs of diverse learners. Following the example set by BCSC, a district UDL plan would unite technology resources, professional development, and instruction into a unified focus. A UDL plan would also ensure that both administrators and teachers had common understandings of UDL and how technology can support its implementation. As UDL gains in awareness and focus at the federal level (Samuels, 2009; Muller & Tschantz, 2003), district adoption of a UDL framework would prove even more beneficial should the federal government support UDL by integrating it into upcoming reauthorization of the Elementary and Secondary Education Act (ESEA). The addition of UDL to ESEA is supported by 28 organizations, including the National School Boards Association, Council for Exceptional Children, National Education Association, and other groups supporting students with disabilities (Samuels, 2009).

Suggested Course of Action

1. It is recommended that the Indiana Department of Education, in collaboration with PATINS, inform key stakeholders on the framework and benefits of UDL through collaborative presentations to Indiana Association of School Principals (IASP), Indiana

Council of Administrators of Special Education (ICASE), and Indiana Association of Public School Superintendents (IAPSS).

2. PATINS staff should collaborate with the nine educational service centers located throughout the state to provide professional development and to support UDL implementation beyond the scope of just those schools participating in the grant program. Professional development should focus on initial UDL trainings for staff with no prior experience with UDL. However, continual professional development should be provided to those who have completed participation. The service centers offer central locations around the state, as well as opportunities for online and virtual trainings.

3. A Universal Design for Learning (UDL) state-wide task force will be created with representation from stakeholder groups, including professional organizations, service centers, and PATINS. A focus of this task force will be to build a common understanding and vision of UDL's application and integration across the state.

4. The Department of Education, in collaboration with PATINS and CAST will create a research study comparing the academic achievement of students and schools in Bartholomew Consolidated School Corporation (BCSC) with another comparable school district in Indiana that has not implemented UDL. The purpose of this study should be to provide analyses of academic achievement data of these districts. These analyses should identify to what degree a district-wide UDL initiative impacts the academic achievement of students.

5. It is recommended that the Indiana Department of Education, through the Effective Assessment and Instruction grant, in collaboration with PATINS, continue to provide training to schools in UDL. However, this training should be provided on a wider

level than current practice allows. Ongoing support and professional development should be provided from DOE staff to all teams, including those who have completed training and those currently in training. Efforts should be made to continue to utilize advances in technology and web-conferencing capabilities to provide alternative means to access and participate in professional development.

References

Abell, M. M. (2006). Administrative attitudes and factors found in special education directors implementing universal design for learning/e-text within a state special education system. *Dissertation Abstracts International, 67*(8). (UMI No. 3228012)

Acrey, C., Johnstone, C., & Milligan, C. (2005). Using universal design to unlock the potential for academic achievement of at-risk learners. *Teaching Exceptional Children, 38,* 22-31.

American Association of School Librarians. (2007). *Standards for the 21st Century Learner.* Retrieved July 3, 2009, from http://www.ala.org/ala/mgrps/divs/aasl/aaslproftools/learningstandards/AASL_LearningStandards.pdf

American Digital Schools. (2006). *The America's Digital Schools 2006 national survey.* Retrieved August 14, 2008, from www.ADS2006.org

Anderson, K. (2007). Differentiating instruction to include all students. *Preventing School Failure, 51,* 49-54.

Anderson, K. M., & Anderson, C. L. (2005). Integrating technology in standards-based instruction. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 521-544). Whitefish Bay, WI: Knowledge by Design, Inc.

Anderson, R. E., & Becker, H. J. (2001). *School investments in instructional technology* (Rep. No. 8). University of California, Irvine, Center for Research on Information Technology and Organizations and University of Minnesota.

Anderson, R. E., & Dexter, S. L. (2000). *School technology leadership: Incidence and* *impact.* University of California, Irvine, Center for Research on Information Technology and Organizations.

Andrews, D., Nonnecke, B., & Preece, J. (2003). Electronic survey methodology: A case study in researching hard-to-involve internet users. *International Journal of Human-Computer Interaction*, *16*(2), 185-210.

Assistive Technology Act of 1998, Pub. L. No. 108-364. Retrieved January 21, 2010, from http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_public_laws&docid=f:publ364.108

Assistive Technology Act of 2004, Pub. L. No. 108-364. Retrieved December 8, 2008, from http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_public_laws&docid=f:publ364.108

Barton, A. E., & Orwig, G. W. (1993). *New technologies for education*. Englewood, CO: Libraries Unlimited.

Baumgartner, T., Lipowski, T., & Rush, C. (2003). Increasing reading achievement of primary and middle school students through differentiated instruction. Unpublished doctoral dissertation, Saint Xavier University, Chicago, IL.

Becker, H. J. (2000). Who's wired and who's not: Children's access to and use of computer technology. *Children and Computer Technology, 10,* 44-75.

Bergen, D., & Coscia, J. (2001). *Brain research and childhood education: Implications for educators.* Olney, MD: Association for Childhood Education International.

Bitner, N., & Bitner, J. (2002). Integrating technology into the classroom: Eight keys to success. *Journal of Technology and Teacher Education, 10,* 95-99.

Blackhurst, A. E. (2005). Historical perspectives about technology applications for people with disabilities. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 3-30). Whitefish Bay, WI: Knowledge by Design, Inc.

Blankenship, S. (1998). *Factors related to computer use by teachers in classroom instruction.* Unpublished doctoral dissertation, Virginia Polytechnic Institute, Blacksburg, VA.

Bodine, C., & Melonis, M. (2005). Team and assistive technology in educational settings. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 209-227). Whitefish Bay, WI: Knowledge by Design, Inc.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Bray, M., Brown, A., & Green, T. D. (2004). *Technology and the diverse learner: A guide to classroom practice.* Thousand Oaks, CA: Corwin Press.

Brierly, J. (1987). *Give me a child until he is seven: Brain studies and early childhood education.* Philadelphia, PA: The Falmer Press.

Brothen, T., & Wambach, C. (2003). Universal instructional design in a computer-based psychology course. In J. L. Higbee (Ed.), *Curriculum transformation and disability: Implementing universal design in higher education* (pp. 127-147). Minneapolis, MN: University of Minnesota.

Campbell, P., & Algozzine, B. (2005). Using technology to enhance collaboration to benefit all students. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 747-776). Whitefish Bay, WI: Knowledge by Design, Inc.

CAST (2007). *Summary of 2007 national summit on universal design for learning working groups.* Wakefield, MA: Author.

CAST (2008). *Universal design for learning guidelines: Version 1.0.* Wakefield, MA: Author.

CAST (2009). *CAST UDL spotlight: A district implements UDL.* Retrieved January 16, 2010, from http://udlspotlight.wordpress.com/2009/11/

Clarfield, J., & Stoner, G. (2005). The effects of computerized reading instruction on the academic performance of students identified with ADHD. *School Psychology Review, 34,* 246-250. Retrieved March 8, 2008, from www.questia.com

Clark, C., & Dugdale, G. (2009). *Young people's writing: Attitudes, behaviour and the role of technology.* London, England: National Literacy Trust. Retrieved March 30, 2010, from http://nlt.tictocdev.com/assets/0000/0771/Writing_survey_2009.pdf

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education.* New York: Routledge Falmer. Retrieved July 1, 2008, from http://www.questia.com

Coley, R. J., Cradler, J., & Engle, P. K. (1997). Computers and classrooms: The status of technology in U.S. schools. Princeton, NJ: Educational Testing Service.

Consortium for School Networking. (n.d.). *Digital leadership divide: Without visionary leadership, disparities in school technology budgets increase.* Washington, DC: Author.

Coppola, E. M. (2004). *Powering up: Learning to teach well with technology.* New York: Teachers College Press.

Cortiella, C. (2007). *Rewards and roadblocks: How special education students are faring under No Child Left Behind.* Retrieved February 20, 2010, from http://www.cehd.umn.edu/NCEO/OnlinePubs/NCLD/NCLDRewardsand Roadblocks.pdf

Cortiella, C. (2008). *Parent advocacy brief: A parent's guide to Universal Design for Learning (UDL).* Retrieved July 18, 2008, from http://www.LD.org

Cortiella, C., & Burnette, J. (2008). *Challenging change: How schools and districts are improving the performance of special education students.* New York, NY: National Center for Learning Disabilities. Retrieved February 20, 2010, from http://www.LD.org

Coyne, P., Ganley, P., Hall, T., Meo, G., Murray, E., & Gordon, D. (2006). Applying Universal Design for Learning in the classroom. In D. H. Rose, & A. Meyer (Eds.), *A practical reader in Universal Design for Learning* (pp. 1-13).

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge, MA: Harvard University Press.

Dalton, B., Pisha, B., Eagleton, M., Coyne, P., & Deysher, S. (2002). *Engaging the text: Strategy instruction in a computer-supported reading environment for struggling readers*. Retrieved March 8, 2008, from http://www.cast.org

Davidson, J., & Noyes, P. (1995). Computer-generated speech feedback as support for reading instruction. *Support for Learning, 10,* 35-39.

Dolan, R. P, & Hall, T. E. (2001). Universal Design for Learning: Implications for large-scale assessment. *IDA Perspectives, 27,* 22-25.

Dolan, R. P., Hall, T. E., Banerjee, M., Chun, E., & Strangman, N. (2005). Applying principles of universal design to test delivery: The effect of computer-based read-aloud on test performance of high school students with learning disabilities. *The Journal of Technology, Learning, and Assessment, 3,* 4-32.

D'Orio, W. (2008, September/October). One laptop one child. *Scholastic Administr@tor,* 44-47.

Dunn, L. M. (1968). Special education for the mildly retarded—Is much of it justifiable? *Exceptional Children, 35,* 5-22.

Dymond, S. K., Renzaglia, A., Rosenstein, A., Chun, E. J., Banks, R. A., Niswander, V., et al. (2006). Using a participatory action research approach to create a universally designed inclusive high school science course: A case study. *Research & Practice for Persons with Severe Disabilities, 31,* 298-308.

Education Technology Council. (2007, January). *Indiana plan for digital-age learning.* Retrieved August 1, 2008, from http://www.indiana-etc.org/pdfs/final_plan.pdf

Edyburn, D. (2006). Failure is not an option: Collecting, reviewing, and acting on evidence for using technology to enhance academic performance. *Learning & Leading with Technology, 34,* 20-23.

Edyburn, D. (2010). Would you recognize Universal Design for Learning if you saw it? Ten propositions for new directions for the second decade of UDL. *Learning Disabilities Quarterly, 33,* 33-41.

Elkind, J., Cohen, D., & Murray, C. (1993). Using computer-based readers to improve reading comprehension of students with dyslexia. *Annals of Dyslexia, 43,* 238-

259.

Eyer, T. L. (1998). Greater expectations: How the 1997 IDEA amendments raise the basic floor of opportunity for children with disabilities. *Education Law Report, 126,* 1-19.

Ferneding, K. A. (2003). *Questioning technology: Electronic technologies and educational reform.* Washington, DC: Peter Lang Publishing, Inc.

Fink, A. (2003). *How to design survey studies* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Fink, R. P. (1995). Successful dyslexics: A constructivist study of passionate interest reading. *Journal of Adolescent & Adult Literacy, 39*(4), 268-280.

Fink, R. P. (1998). Literacy development in successful men and women with dyslexia. *Annals of Dyslexia, 48,* 311-346.

Fuchs, D., & Fuchs, L. S. (2006). Introduction to response to intervention: What, why, and how valid is it? *Reading Research Quarterly, 41,* 93-99.

Fullan, M. F. (2000). The three stories of education reform. *Phi Delta Kappan, 81,* 581-588. Retrieved April 4, 2008, from http://www.questia.com

Gardner, H. (1993). *Multiple intelligences: The theory in practice.* New York: Basic Books.

Gardner, H., & Hatch, T. (1989). Multiple intelligences go to school: Educational implications of the theory of multiple intelligences. *Educational Researcher, 18,* 4-10.

Garland, V. E. (2009-2010). Emerging technology trends and ethical practices for the school principal. *Journal of Educational Technology Systems, 38*, 39-50.

Gartner, A., & Lipsky, D. K. (1987). Beyond special education: Toward a quality system for all students. *Harvard Education Review, 57,* 367-395.

George, P. S. (2005). A rationale for differentiating instruction in the regular classroom. *Theory Into Practice, 44,* 185-193.

Given, B. K. (2002). *Teaching to the brain's natural learning systems.* Alexandria, VA: Association for Supervision and Curriculum Development.

Gordon, D. T. (2003). Curriculum access in the digital age. In D. T. Gordon (Ed.), *Better teaching and learning in the digital classroom* (pp. 79-89). Cambridge, MA: Harvard Education Press.

Gordon, D. T. (2009). School reform: Are we just getting started? In D. T. Gordon, J. W. Gravel, & L. A. Schifter (Eds.), *A policy reader in Universal Design for Learning* (pp. 19-33).

Grabinger, R. S., Aplin, C., & Ponnappa-Brenner, G. (2008). Supporting learners with cognitive impairments in online environments. *TechTrends, 52,* 63-69.

Gregg, L. (2007). Crossing the canyon: Helping students with special needs achieve proficiency. In D. Reeves (Ed.), *Ahead of the curve: The power of assessment to transform teaching and learning* (pp. 165-181). Bloomington, IN: Solution Tree.

Gregory, G. H. (2005). *Differentiating instruction with style: Aligning teacher and learner intelligences for maximum achievement.* Thousand Oaks, CA: Corwin Press.

Green, F. (1999). Brain and learning research: Implications for meeting the needs of diverse learners. *Education, 119,* 682-688.

Greene, J. C. (2005). The generative potential of mixed methods inquiry. *International*

Journal of Research and Method in Education, 28, 207-211.

Griggs, S., & Dunn, R. (1995). Hispanic-American students and learning style. *Emergency Librarian, 23,* 11-14.

Gulpinar, M. (2005). The principles of brain-based learning and constructivist models in education. *Educational Sciences: Theory & Practice, 5,* 299-306.

Hall, T., Meyer, A., & Strangman, N. (2005). UDL implementation: Examples using best practices and curriculum enhancements. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 149-197). Cambridge, MA: Harvard Education Press.

Hall, T., Strangman, N., & Meyer, A. (2003). *Differentiated instruction and implications for UDL implementation.* Washington, DC: National Center on Accessing the General Curriculum. Retrieved June 26, 2008, from http://www.cast.org/publications/ncac/ncac_diffinstructudl.htm

Harac, L. (2004). A level playing field. *Teacher Magazine, 16,* 40-45. Retrieved June 8, 2009 from http://web.ebsco.com

Hardiman, M. M. (2001). Connecting brain research with dimensions of learning. *Educational Leadership, 59,* 52-55.

Hasselbring, T. S., & Williams Glaser, C. H. (2000). Use of computer technology to help students with special needs. *The Future of Children, 10,* 102-122.

Hasselbring, T. S., Lott, A. C., & Zydney, J. M. (2006). *Technology supported math instruction for students with disabilities: Two decades of research and development.* Retrieved June 23, 2008, from http://www.cited.org

Hatfield, J. P. (2003). Perceptions of universal (instructional) design: A qualitative examination. In J. L. Higbee (Ed.), *Curriculum transformation and disability: Implementing universal design in higher education* (pp. 41-57). Minneapolis, MN: University of Minnesota.

Hehir, T. (2005). *New directions in special education: Eliminating ableism in policy and practice.* Cambridge, MA: Harvard Education Press.

Hehir, T. (2009). Policy foundations of Universal Design for Learning. In D. T. Gordon, J. W. Gravel, & L. A. Schifter (Eds.), *A policy reader in Universal Design for Learning* (pp. 35-45).

Heimann, M., Nelson, K. E., Tjus, T., & Gillberg, C. (1995). Increasing reading and communication skills in children with autism through an interactive multimedia computer program. *Journal of Autism & Developmental Disorders, 25,* 459-480.

Higher Education Opportunity Act, 20 U.S.C. 1001 (2008).

Hitchcock, C., Meyer, A., Rose, D. H., & Jackson, R. (2005). Equal access, participation, and progress in the general education curriculum. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 37-68). Cambridge, MA: Harvard Education Press.

Hitchcock, C., & Stahl, S. (2003). Assistive technology, universal design, universal design for learning: improving learning opportunities. *Journal of Special Education Technology, 18*. Retrieved April 1, 2008, from http://jset.unlv.edu/18.4/hitchcock/Hitchcock.pdf

Individuals with Disabilities Act (IDEA) of 1997, Pub. L. 105-17, 20 U.S.C. § 1400 *et seq.*

Individuals with Disabilities Improvement Act (IDEIA) Amendments of 2004, Pub. L. 108-446, 20 U.S.C. § 1400 *et seq.*

The information edge: Using data to accelerate achievement. (2006). Retrieved February 7, 2008, from Editorial Projects in Education Research Center Web site: http://www.edweek.org/rc

Jaber, W. E., & Moore, D. M. (2002). A survey of factors which influence teachers' use of computer-based technology. *International Journal of Instructional Media, 26,* 253-264. Retrieved April 3, 2008, from http://www.questia.com

Jackson, R., & Harper, K. (2005). Teacher planning for accessibility: The universal design of learning environments. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 101-123). Cambridge, MA: Harvard Education Press.

Jackson, R., Harper, K., & Jackson, J. (2005). Teaching for accessibility: Effective practices, classroom barriers. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 125-147). Cambridge, MA: Harvard Education Press.

Jenkins, J. R., Antil, L. R., Wayne, S. K., & Vadasy, P. F. (2003). How cooperative learning works for special education and remedial students. *Exceptional Children, 69,* 279-294. Retrieved April 4, 2008, from www.questia.com

Jensen, E. (1998). *Teaching with the brain in mind.* Alexandra, VA: Association for Supervision and Curriculum Development.

Johnson, B., & Christensen, L. (2000). *Educational research: Quantitative and* *qualitative approaches.* Boston, MA: Allyn and Bacon.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33,* 14-26.

Johnstone, C. J. (2003). *Improving validity of large-scale tests: Universal design and student performance* (Technical Report 37). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Karger, J. (2005). What IDEA and NCLB suggest about curriculum access for students with disabilities. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 69-100). Cambridge, MA: Harvard Education Press.

Kauffman, J. M., Bantz, J., & McCullough, J. (2002). Separate and better: A special public school class for students with emotional and behavioral disorders. *Exceptionality, 10,* 149-170.

Kauffman, J. M., & Hallahan, D. P. (2005). Toward a comprehensive delivery system for special education. In J. M. Kauffman & D. P. Hallahan (Eds.), *The illusion of full inclusion: A comprehensive critique of a current special education bandwagon* (pp. 149-184).

Kerstholt, M. T., van Bon, W. H. J., & Schreuder, R. (1994). Training in phonemic segmentation: The effects of visual support. *Reading and Writing: An Interdisciplinary Journal, 6*, 361-385.

Ketterlin-Geller, L. R. (2005). Knowing what all students know: Procedures for developing universal design for assessment. *Journal of Technology, Learning, and Assessment, 4,* 1-23. Retrieved February 20, 2010, from http://www.jtla.org

KewalRamani, A., Gilbertson, L., Fox, M., & Provasnik, S. (2007). *Status and trends in The education of racial and ethnic minorities* (NCES 2007-039). Washington, DC: National Center for Education Statistics, Institute of Education Sciences. Retrieved March 8, 2008, from http://nces.ed.gov/fastfacts

King-Spears, M. (2009). Universal Design for Learning: Technology and pedagogy. *Learning Disability Quarterly,* 32, 199-201.

Kleiman, G. M. (2004). Myths and realities about technology in K-12 schools: Five years later. *Contemporary Issues in Technology and Teacher Education, 4,* 248-253.

Kortering, L., McClannon, T., & Braziel, P. (2005). What algebra and biology students have to say about universal design for learning. *Research to Practice Brief: Improving Secondary Education and Transition Services Through Research, 4*. Retrieved April 2, 2008, from http://www.ncset.org

Kulik, J. A. (2003). *Effects of using instructional technology in elementary and secondary schools: What controlled evaluation studies say*. (SRI Project Number P10446.001). Arlington, VA: SRI International. Retrieved June 20, 2009, at http://www.sri.com/policy/csted/reports/sandt/it

Lee, S., Amos, B. A., Gragoudas, S., Lee, Y., Shogren, K. A., Theoharis, R., et al. (2006). Curriculum augmentation and adaptation strategies to promote access to the general curriculum for students with intellectual and developmental disabilities. *Education and Training in Developmental Disabilities, 41,* 199-212.

Levin, D, & Arafeh, S. (2002) *The digital disconnect: The widening gap between internet-savvy students and their schools.* Washington, DC: American Institutes for Research for Pew Internet & American Life Project. Retrieved October 8, 2009, from http://www.pewinternet.org/PPF/r/67/report_display.asp

Lewin, C. (1997). Test driving: CARS: Addressing the issues in the evaluation of computer-assisted reading software. *Journal of Computing in Childhood Education, 8,* 111-132.

Lewin, C. (2000). Exploring the effects of talking book software in UK primary classrooms. *Journal of Research in Reading, 23,* 149-157.

Lou, Y., Abrami, P., Spence, J., Poulsen, C., Chambers, B., & d'Apollonia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research, 66,* 423-458.

Mace, R. L., Hardie, G. J., & Place, J. P. (1996). *Accessible environments: Toward universal design.* North Carolina State University. Retrieved May 1, 2010 from http://www.design. ncsu.edu/cud/pubs_p/docs/ACC%20Environments.pdf

MacNeil, A. J., & Delafield, D. P. (1998). Principal leadership for successful school technology implemention. *Technology and Teacher Education Annual.* (ERIC Document Reproduction Service No. ED421126)

Macomb Intermediate School District's UDL Initiative. (n.d.). *Macomb UDL survey.* Retrieved August 27, 2008, from http://e3t.org/

Marascuilo, L. A., & Serlin, R. R. (1988). *Statistical methods for the social and behavioral sciences*. New York: W.H. Freeman and Company.

Mason, C., Orkwis, R., & Scott, R. (2005). Instructional theories supporting Universal Design for Learning—teaching to individual learners. In J. Castellani (Ed.), *Universal Design for Learning: A guide for teachers and education professionals* (pp. 21-40). Alexandria, VA: Council for Exceptional Children

McDonald, J. H. (2009). *Handbook of Biological Statistics* (2nd ed.). Baltimore, MD: Sparky House Publishing. Retrieved January 20, 2010, from http://udel.edu/~mcdonald/statanovasig.html

McGrew, K. S., Thurlow, M. L., & Spiegel, A. N. (1993). An investigation of the exclusion of students with disabilities in national data collection programs. *Educational Evaluation and Policy Analysis, 15,* 339–352.

McGuire, J. M., Scott, S. S., & Shaw, S. F. (2006). Universal design and its applications in educational environments. *Remedial and Special Education, 27.* Retrieved March 15, 2008, from http://www.questia.com

McTighe, J., & Brown, J. L. (2005). Differentiated instruction and educational standards: Is détente possible? *Theory Into Practice, 44,* 234-244.

Meo, G. (2008). Curriculum planning for all learners: Applying Universal Design for Learning (UDL) to a high school reading comprehension program. *Preventing School Failure, 52,* 21-30.

Metcalf, D., Evans, C., Flynn, H. K., & Williams, J. B. (2009). Direct instruction + UDL = Access for diverse learners: How to plan and implement an effective multisensory spelling lesson. *Teaching Exceptional Children Plus, 5*. Retrieved March 10, 2010, from http://escholarship.bc.edu/education/tecplus/vol5/iss6/art2

Meyer, A., & Rose, D. H. (1998). *Learning to read in the computer age.* Cambridge, MA: Brookline Books.

Meyer, A., & Rose, D. H. (2000). Universal design for individual differences. *Educational Leadership, 58,* 39-43.

Meyer, A., & Rose, D. H. (2005). The future is in the margins: The role of technology and disability in educational reform. In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), *The universally designed classroom: Accessible curriculum and digital technologies* (pp. 13-35). Cambridge, MA: Harvard Education Press.

Microsoft Corporation. (2008). *Explore the education competencies.* Retrieved August 14, 2008, from http://www.microsoft.com/education/competencies/ allcompetencies.mspx

Mitchell, M. J., & Fox, B. J. (2001). The effects of computer software for developing phonological awareness in low-progress readers. *Reading Research and Instruction, 40*, 315-332.

Mueller, J. L., & Mace, R. L. (1998). *The universal design file: Designing for people of all ages and abilities*. Retrieved June 12, 2008, from http://www.udeducation.org/ resources/readings/mueller_mace.asp

Muller, E., & Tschantz, J. (2003). Universal Design for Learning: Four state initiatives. *Project FORUM at National Association of State Directors of Special Education*. Alexandria, VA: U.S. Department of Education Office of Special Education and Rehabilitative Services.

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform.* Washington, DC: U.S. Department of Education. Retrieved February 23, 2010, from http://www.ed.gov/pubs/ NatAtRisk/index.html

National Instructional Materials Accessibility Standard: Final Rule, 34 C.F.R. Part 300 (2006).

Navarro, M. V. (2008). Support mechanisms necessary for the implementation of technology by teachers. *Dissertation Abstracts International, 69*(2). (UMI No. 3297209)

No Child Left Behind Act of 2001, Pub. L. 107-110, H.R.1, 115 Stat. 1425 (2001).

Noble, T. (2004). Integrating the revised Bloom's taxonomy with multiple intelligences: A planning tool for curriculum differentiation. *Teachers College Record, 106,* 193-211.

Nolet, V., & McLaughlin, M. J. (2000). *Accessing the general curriculum: Including students with disabilities in standards-based reform.* Thousand Oaks, CA: Corwin Press, Inc.

Olofsson, A. (1992). Synthetic speech and computer aided reading for reading disabled children. *Reading and Writing: An Interdisciplinary Journal, 4,* 165-178.

Orkwis, R., & McLane, K. (1998). A curriculum every student can use: Design principles for student access. *ERIC Clearinghouse on Disabilities and Gifted Education.* Retrieved July 11, 2009, from http://www.eric.ed.gov

PATINS Project (n.d.). *Universal Design for Learning (UDL) pilot program?* Retrieved September 13, 2008, from http://www.patinsproject.com/universal_design_for_learning_project_files/udl_new.pdf

Peck, C., Cuban, L., & Kirkpatrick, H. (2002). Techno-promoter dreams, student realities. *Phi Delta Kappan, 83,* 472-482. Retrieved April 4, 2008, from www.questia.com

Perkins, D. (1995). *Outsmarting IQ: The emerging science of learnable intelligence.* New York: The Free Press.

Pisha, B., & Coyne, P. (2001). Smart from the start: The promise of Universal Design for

Learning. *Remedial and Special Education, 22,* 197-203.

Pisha, B., & Stahl, S. (2005). The promise of new learning environments for students with disabilities. *Intervention in School and Clinic, 41,* 67-75.

Prensky, M. (2001, September/October). Digital natives, digital immigrants. *On the Horizon, 9*, 1-6.

Project Tomorrow. (2006). *Our voices, our future: Student and teacher views on science, technology, & education.* Irvine, CA: Author. Retrieved July 25, 2009, from http://www.tomorrow.org/Speakup/pdfs/SpeakUpReport_05.pdf

Project Tomorrow. (2009). *Speak up 2008 for students, teachers, parents, and administrators.* Retrieved March 26, 2010, from http://www.tomorrow.org

Rakes, G. C., Fields, V. S., & Cox, K. E. (2006). The influence of teachers' technology use on instruction practices. *Journal of Research on Technology in Education, 38,* 409-424.

Rainie, L. (2004, April 13). *Internet and American life.* Retrieved July 18, 2008, from http://www.pewinternet.org /pdfs/PIP_Preparedness_Net_Memo.pdf

Ravitz, J., Wong, Y., & Becker, H. (1999). *Teaching, learning, and computing: 1998.* Retrieved April 20, 2008, from http://www.crito.uci.edu/tlc/findings/ special_report/index.htm

Rea, L. M., & Parker, R. A. (1992). *Designing and conducting survey research.* San Francisco, CA: Jossey-Bass Inc.

Reynolds, M. C., Wang, M. C., & Wahlberg, H. J. (1987). The necessary restructuring of special and regular education. *Exceptional Children, 53,* 391-398.

Rice, M. L., Wilson, E. K., & Bagley, W. (2001). Transforming learning with technology: Lessons from the field. *Journal of Technology and Teacher Education, 9,* 211-223. Retrieved March 28, 2006, from http://www.questia.com

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2010). *Generation M2: Media in the lives f 8-to18-year-olds.* Kaiser Family Foundation.

Rose, D. H., & Dalton, B. (2006). Engaging the text: Brain research and the universal design of reading strategy supports. In D. H. Rose, & A. Meyer (Eds.), *A practical reader in Universal Design for Learning* (pp. 133-148).

Rose, D. H., & Gravel, J. W. (2009). Getting from here to there: UDL, global positioning systems, and lessons for improving education. In D. T. Gordon, J. W. Gravel, & L. A. Schifter (Eds.), *A policy reader in Universal Design for Learning* (pp. 5-18).

Rose, D. H., Hasselbring, T. S., Stahl, S., & Zabala, J. (2005). Assistive technology and Universal Design for Learning: Two sides of the same coin. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 507-518).

Rose, D. H., & Meyer, A. (2002). Teaching every student in the digital age: Universal Design for Learning. Alexandria, VA: Association for Supervision and Curriculum Development.

Rose, D. H., Meyer, A., & Hitchcock, C. (2005). *The universally designed classroom: Accessible curriculum and digital technologies.* Cambridge, MA: Harvard Education Press.

Rushton, S., & Larkin, E. (2001). Shaping the learning environment: Connecting developmentally appropriate practices to brain research. *Early Childhood*

Education Journal, 29, pp. 25-33.

Russell, M., Bebell, D., O'Dwyer, L., & O'Connor, K. (2003). Examining teacher technology use: Implications for preservice and inservice teacher preparation. *Journal of Teacher Education, 54,* 297-310.

Samuels, C. A. (2009). Universal design concept pushed for education. In D. T. Gordon, J. W. Gravel, & L. A. Schifter (Eds.), *A policy reader in Universal Design for Learning* (pp. 127-131).

Sandholtz, J., Ringstaff, C., & Dwyer, D. (1997). *Teaching with technology: Creating student-centered classrooms.* New York: Teachers College Press.

Shany, M. T., & Bielmiller, A. (1995). Assisted reading practice: Effects on performance for poor readers in grades 3 and 4. *Reading Research Quarterly, 30,* 382-395.

Shores, C., & Chester, K. (2009). *Using RTI for school improvement: Raising every student's achievement scores.* Thousand Oaks, CA: Corwin Press.

Siemens, G. (2004, December 12). *Connectivism: A learning theory for the digital age.* Retrieved August 1, 2008, from http://www.elearnspace.org/Articles/ connectivism.htm

Silver, H. F., Strong, R. W., & Perini, M. J. (2000). *So each may learn: Integrating learning styles and multiple intelligences.* Alexandria, VA: Association for Supervision and Curriculum Development.

Silver-Pacuilla, H. (2006). *Moving toward solutions: Assistive and learning technology for all students.* Washington, DC: National Center for Technology Innovation. Retrieved June 23, 2008, from http://www.nationaltechcenter.org

Singer, J. D. (2005). Should special education merge with regular education? In J. M.

Kauffman & D. P. Hallahan (Eds.), *The illusion of full inclusion: A comprehensive critique of a current special education bandwagon* (pp. 7-24).

Skrtic, T. M., Harris, K. R., & Shriner, J. G. (2005). *Special education policy and practice: Accountability, instruction, and social challenges.* Denver, CO: Love Publishing Company.

Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., & Angeles, J. (2000). Teachers' tools for the 21st century: A report on teachers' use of technology (NCES 2000-102).

Solomon, G., & Schrum, L. (2007). *Web 2.0: New tools, new schools.* Washington, DC: International Society for Technology in Education.

Sopko, K. M. (2008, June). *Universal Design for Learning: Implementation in six local education agencies.* Alexandria, VA: National Association of State Directors of Special Education. Retrieved July 2, 2008, from http://www.projectforum.org

Soukup, J. H., Wehmeyer, M. L., Bashinski, S. M., & Bovaird, J. A. (2007). Classroom variables and access to the general curriculum for students with disabilities. *Exceptional Children, 74,* 101-120. Retrieved July 18, 2008, from http://www.questia.com

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. M. (2007). Effects of training in Universal Design for Learning on lesson plan development. *Remedial and Special Education, 28,* 108-116.

Stahl, S. (2006). Transforming the textbook to improve learning. In D. H. Rose, & A. Meyer (Eds.), *A practical reader in Universal Design for Learning* (pp. 103-132).

Staples, A., Pugach, M. C., & Himes, D. (2005). Rethinking the technology integration challenge: Cases from three urban elementary schools. *Journal of Research on Technology in Education, 37,* 285-311.

Strangman, N., & Dalton, B. (2005). Using technology to support struggling readers: A review of the research. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 545-569). Whitefish Bay, WI: Knowledge by Design, Inc.

Strangman, N., Hitchcock, C., Hall, T. E., Meo, G., & Coyne, P. (2009). Response to intervention and Universal Design for Learning: How might they intersect in the general education classroom? In D. T. Gordon, J. W. Gravel, & L. A. Schifter (Eds.), *A policy reader in Universal Design for Learning* (pp. 155-164).

Sylwester, R. (1995). *A celebration of neurons: An educators guide to the human brain.* Alexandria, VA: Association for Supervision and Curriculum Development.

Thompson, S. J., Johnstone, C. J., & Thurlow, M. L. (2002). *Universal design applied to large scale assessments* (Synthesis Report 44). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved March 8, 2008, from http://education.umn.edu/NCEO/OnlinePubs/Synthesis44.html

Tieso, C. (2005). The effects of grouping practices and curricular adjustments on achievement. *Journal for the Education of the Gifted, 29,* 60-89. Retrieved July 18, 2009, from http://www.prufrock.com

Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners.* Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. A. (2001). *How to differentiate instruction in mixed-ability classrooms.*

Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. A. (2004). Sharing responsibility for differentiating instruction. *Roeper Review, 26,* 188-189.

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., et al. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. *Journal for the Education of the Gifted, 27,* 119-145.

U.S. Department of Commerce, U.S. Department of Education, & NetDay (2005). *Visions 2020.2: Student views on transforming education and training through advanced technologies.* Retrieved July 1, 2009, from http://www2.ed.gov/about/offices/list/os/technology/plan/2004/site/documents/visions_20202.pdf

U.S. Department of Education, National Center for Education Statistics. (2006). *Public elementary and secondary students, staff, schools, and school districts: School year 2003-04* (NCES 2006–307). Retrieved March 8, 2008, from http://nces.ed.gov/fastfacts/display.asp?id=96

U.S. Department of Education Office of Special Education and Rehabilitative Services. (2002). *A new era: Revitalizing special education for children and their families.* Washington, DC: Education Publications Center.

U.S. Department of Education Office of Special Education and Rehabilitative Services, Office of Special Education Programs. (2009). *28th annual report to Congress on the implementation of the Individuals with Disabilities Education Act, 2006.* Washington, DC: Education Publications Center.

VanTassel-Baska, J., Feng, A. X., Brown, E., Bracken, B., Stambaugh, T., French, H (et al.). (2008). A study of differentiated instructional change over 3 years. *Gifted Child Quarterly, 52,* 297-312.

Vygotszky, L. S. (1978). *Mind in society: The development of higher order psychological processes.* Cambridge, MA: Harvard University Press.

Wahl, L., & Duffield, J. (2005). *Using flexible technology to meet the needs of diverse learners: What teachers can do.* San Francisco, CA: WestEd. Retrieved December 9, 2007, from http://www.wested.org/cs/we/view/rs/763

Wehmeyer, M. L. (1999). Assistive technology and students with mental retardation: Utilization and barriers. *Journal of Special Education Technology, 14,* 50-60.

Wehmeyer, M. L. (2006). Universal Design for Learning, access to the general education curriculum and students with mental retardation. *Exceptionality, 14,* 225-235.

Wehmeyer, M. L., Lance, D., & Bashinski, S. (2002). Promoting access to the general curriculum for students with mental retardation: A multi-level model. *Education and Training in Mental Retardation and Developmental Disabilities, 37,* 223-234.

Wehmeyer, M. L., Lattin, D., & Agran, M. (2001). Achieving access to the general curriculum for students with mental retardation: A curriculum decision-making model. *Education and Training in Mental Retardation and Developmental Disabilities, 36,* 327-342.

Wehmeyer, M. L., Smith, S. J., & Davies, D. K. (2005). Technology use and students with intellectual disabilities: Universal design for all students. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 309-323). Whitefish Bay, WI: Knowledge by Design, Inc.

Weisberg, H. F., Krosnick, J. A., & Bowen, B. D. (1996). *An introduction to survey* *research, polling, and data analysis.* Thousand Oaks, CA: Sage Publications, Inc.

Welkowitz, J., Cohen, B. H., & Ewen, R. B. (2006). *Introductory statistics for the behavioral sciences*. Hoboken, NJ: John Wiley & Sons, Inc.

Will, M. C. (1986). Educating children with learning problems: A shared responsibility. *Exceptional Children, 52,* 411-415.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal, 39,* 165-205.

Wolfe, P. (2001). *Brain matters: Translating research into classroom practice.* Alexandria, VA: Association for Supervision and Curriculum Development.

Xu, J. (2005). *SPSS in Windows: ANOVA*. Retrieved November 23, 2009, from https://umdrive.memphis.edu/yxu/public/SPSS%20ANOVA.pdf

Yell, M. L., Drasgow, E., Bradley, R., & Justesen, T. (2004). Contemporary legal issues in special education. In A. M. Sorrells, H. J. Rieth, & P. T. Sindelar (Eds.), *Critical issues in special education: Access, diversity, and accountability* (pp. 16-37).

Zeisel, J. (2001). Universal design to support the brain and its development. In W. F. E. Preiser (Editor In Chief) and E. Ostroff (Sr. Editor), *Universal design handbook* (pp. 8.1-8.14). New York: McGraw-Hill.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for classroom technology innovations. *Teachers College Record, 104,* 482-515.

APPENDIX A

Sampling and Recruitment Documents

The information below was provided via communication with building administrators requesting permission to conduct the survey. Phone calls and/or emails were made to each building administrator of participating schools.

Script:

Hello. My name is Scott Wyndham and I am the Assistant Director of Special Education for the MSD of Wayne Township. I am also currently a doctoral student in the Special Education Department at Ball State University. I have completed all coursework for my degree and am now preparing to conduct research for my dissertation. My study is focusing on those schools that have participated in the PATINS Universal Design for Learning (UDL) Project over the last 5 years. I hope to survey all staff at your school, both those who participated in the UDL project and those who did not. This will allow me to draw conclusions about the impact of the training and to provide to a growing research base on how a UDL framework can be used to impact instruction. I am hoping to use your building as a part of my study, since you have a team that has participated in the UDL project. All identifying information will be strictly confidential. Each participant will receive an explanation of the study and the survey they are asked to complete, as well as a consent form. They can choose to not participate at any time.

If you agree to participate, I will send your staff an email with the link to the survey at the beginning of September.

Thank you for your consideration and support of this research.

The information below was emailed to building principals after initial contact to explain the research and request their school's participation. The researcher provided this information to building principals to share with their staff in order to recruit their participation in the research.

Our school has the opportunity to participate in valuable research investigating how we differentiate our instruction and how technology can be used to meet the needs of diverse learners. We have been asked to participate in this research because a team from our school has participated in a Universal Design for Learning professional development opportunity sponsored through the Partnership for Assistive Technology in Indiana Schools (PATINS) Project at the Indiana Department of Education. In the coming days, you will be receiving an email from Scott Wyndham, a graduate student from Ball State University who is working on his doctorate. Within his email will be a survey link that will direct you to a web-based survey. Please consider taking a few minutes of your time to complete this survey.

APPENDIX B

Teacher Survey

All teachers were surveyed electronically via email. They were sent an email, which was the letter of introduction. The letter contained a link which took them to the website where the survey was located. Respondents indicated their informed consent by clicking “I Agree” or “I Decline” after being presented with the research study information.

Dear ______________,

I am requesting your participation in a survey of school personnel from across Indiana that will contribute to the completion of my doctoral dissertation. You were selected because a team of teachers and administrators from your school have participated in professional development in Universal Design for Learning (UDL) provided through the Indiana Department of Education.

Even if you did not participate in the UDL training, your input is valuable. This online survey will examine how instruction is differentiated in your class or school to meet the needs of diverse learners and how technology is used to facilitate that differentiation.

The link below will direct you to an Internet-based survey. The survey should take less than 10 minutes to complete. Participation is voluntary and you can decline at any time. However, your participation will provide valuable information about how instruction can be differentiated to meet the needs of diverse learners.

The survey will be available until September 16th and your participation would be greatly appreciated.

http://inquisitor.bsu.edu/inqsit/inqsit.cgi/wyndham?Teacher+Survey!1102005

Sincerely,

Scott Wyndham

Assistant Director of Special Services

MSD of Wayne Township

(317) 988-7931

Study Title: School Faculty Perceptions of the Use of Technology to Accommodate Diverse Learners: A Universal Design for Learning Framework

Study Purpose and Rational: The purpose of this research project is to examine how training and professional development in Universal Design for Learning affects school faculty's perceptions of differentiating instruction and using technology to address the needs of diverse learners. Findings from this research will be added to a growing research base in how Universal Design for Learning principles can be of benefit to teachers and students.

Participation Procedures and Duration: For this project you will be asked to complete a survey. It will take approximately 10-15 minutes to complete.

Data Confidentiality: All data will be maintained as confidential and no identifying information such as names will appear in any written work concerning this study including any publication or presentation of the data.

Storage of Data: Survey data will be entered into a software program and stored on the researcher's password protected computer in a locked office for two years and then deleted.

Risks or Discomforts: There should be no risk or discomfort from participating in this project.

Benefits: The benefits of participating in this project will be a broader understanding of how Universal Design for Learning principles can impact education.

Voluntary Participation: Your participation in this survey is completely voluntary and you are free to withdraw your permission at any time and for any reason.

IRB Contact Information: For one's rights as a research subject, you may contact Research Compliance, Office of Academic Research and Sponsored Programs, Ball State University, Muncie, IN 47306, (765) 285-5070, irb@bsu.edu.

Researcher Contact Information:
Principal Investigator: Scott Wyndham, (317) 839-0243, scott.wyndham@wayne.k12.in.us
Faculty Sponsor: Dr. Michael Harvey, (765) 285-5715, mwharvey@bsu.edu

To proceed with this survey, please click "I Agree" below.
To decline participation, please click "I Decline" below.

BALL STATE UNIVERSITY
EDUCATION REDEFINED

Important Information:

- Your responses will not be recorded until you click the button at the end of this page.

About This Survey

This survey is intended to obtain information about accommodating diverse learners and how technology is used to engage students, present material, and assess students. This research is specifically interested in whether training in Universal Design for Learning (UDL) changes teachers' perceptions about the curriculum, instruction, and assessments that they use in their classrooms.

This study will identify the perceptions of school faculty in the following areas: the inclusion of students with disabilities, how technology is used in classrooms, differentiating instruction, and student engagement. Additionally, factors that positively impact the use of technology to accommodate the needs of all learners will also be analyzed.

Your participation in this study is appreciated. Your responses will help identify ways that UDL can be supported throughout schools to accommodate the needs of all learners.

Section I. – Demographics

This section of the survey will ask some background information about your experiences and position within your school.

1. For the purposes of this research, in which category do you most consider yourself?

   ○ A. General Education Teacher

   ○ B. Special Education Teacher

---

2. What is the best description of the school/district in which you work?

   ○ A. Elementary

   ○ B. Middle School/Jr High

   ○ C. High School

- D. District Level
- E. Other

Please describe

---

3. What is your age?
   - A. Under 24
   - B. 25-34
   - C. 35-44
   - D. 45-54
   - E. 55 and over

---

4. How many years have you been working in education?
   - A. 0-5 years
   - B. 6-10 years
   - C. 11-20 years
   - D. 20+ years

---

5. Have you participated in the Universal Design for Learning (UDL) Grant Initiative through the PATINS Project?
   - A. Yes. I am currently participating in the PATINS UDL Project.
   - B. Yes. I have completed participation in the PATINS UDL Project.
   - C. No.

---

6. Have you participated in any Universal Design for Learning (UDL) trainings within your school or district?
   - A. Yes
   - B. No

---

7. Have you participated in any other technology professional development opportunities in the last 5 years?
   - A. Yes (please describe)
   - B. No

If yes, please describe

Section II. – Classroom/School Perceptions

This section of the survey will address your perceptions of addressing students with diverse needs in general education classrooms. ***Please rate on a 100 point scale with Strongly Disagree being 0-25, Disagree being 26-50, Agree being 51-75, and Strongly Agree being 76-100.***

8.

Please rate using the Likert-type Scale	**Strongly Disagree (0-25)**	**Disagree (26-50)**	**Agree (51-75)**	**Strongly Agree (76-100)**	**Do not know**
Students with disabilities in my school are adequately included into general education classrooms.	○	○	○	○	○
Students with disabilities who are included in general education classrooms are making adequate progress toward the grade-level standards in the curriculum being taught.	○	○	○	○	○
The primary responsibility for accommodating classroom activities for students with disabilities included in general education classrooms lies with special education teachers.	○	○	○	○	○
Accommodations designed for students with disabilities usually create increased opportunities for all learners.	○	○	○	○	○
The more choice that students have in their instruction and assessment, the more engaged they will be in the material being presented.	○	○	○	○	○

Section III. - Classroom Strategies

This section of the survey addresses how instruction is differentiated within your classroom. Please indicate how often the following statements apply within your classroom.

9.

Please rate using the Likert-type Scale	**Never (not at all)**	**Sometimes (1-2 times/month)**	**Often (1-2 times/week)**	**Very Often (Daily)**	**Do not know**

I present material to my students through multiple means to allow for more flexibility in instruction.	◌	◌	◌	◌	◌
Students in my class are presented with choices in how they receive core instruction.	◌	◌	◌	◌	◌
I utilize technology in my class to provide students with more choice and flexibility in completing assignments.	◌	◌	◌	◌	◌
I utilize technology in my class to present material in ways that support all students learning.	◌	◌	◌	◌	◌
I utilize technology to present material in a way that actively engages students in their learning.	◌	◌	◌	◌	◌
Students in my class are given choices in how they are assessed and demonstrate their learning.	◌	◌	◌	◌	◌
Students in my class are presented with opportunities to express what they have learned using technology.	◌	◌	◌	◌	◌
I utilize technology in my class to provide ongoing assessments of student progress.	◌	◌	◌	◌	◌

---

10. **Please indicate how often students in your class use technology in the following ways.**

Please rate using the Likert-type Scale	**Never (not at all)**	**Sometimes (1-2 times/month)**	**Often (1-2 times/week)**	**Very Often (Daily)**	**Do not know**
Word Processing	◌	◌	◌	◌	◌
Research	◌	◌	◌	◌	◌

Drill and practice of specific skills	○	○	○	○	○
Software programs to learn new skills	○	○	○	○	○
Software programs to reinforce concepts and skills previously learned	○	○	○	○	○
Assessments/tests online	○	○	○	○	○
Homework online	○	○	○	○	○
Multi-media presentations (e.g., Power Point)	○	○	○	○	○
Communication with other students/teachers (e.g., e-mail, blogs, podcasts)	○	○	○	○	○
Text-to-speech programs	○	○	○	○	○
Organization (e.g., graphs, tables, spreadsheets, graphic based organizers)	○	○	○	○	○
Interactive presentation technology (e.g., Smart Boards)	○	○	○	○	○
Mobile technology (e.g., Palm Pilots, ipods)	○	○	○	○	○
Interactive assessments (e.g., Classroom Response Systems)	○	○	○	○	○
Web based tools (e.g., wikis, blogs, social networks)	○	○	○	○	○

Section IV. - Factors Impacting Technology Integration

This section of the survey addresses facts that impact how technology is used by teachers. Please indicate how important the following factors are in supporting technology integration within your class. *Please rate on a 100 point scale with Not Important being 0-25, Somewhat Important being 26-50, Important being 51-75, and Very Important being 76-100.*

11.

Please rate using the Likert-type Scale	**Not Important (0-25)**	**Somewhat Important (26-50)**	**Important (51-75)**	**Very Important (76-100)**	**Do not know**

A school-wide technology plan with clear expectations for teachers and students.	○	○	○	○	○
A principal that models the use of technology in daily school activities.	○	○	○	○	○
Encouragement from the principal to utilize technology within the classroom.	○	○	○	○	○
Professional development focusing on utilizing technology to accommodate diverse students.	○	○	○	○	○
Collaboration with other teachers, technology personnel, and administrators.	○	○	○	○	○
Recognition from the principal when utilizing technology within the classroom.	○	○	○	○	○
Involvement in administrative decisions about technology, uses, functions, and locations.	○	○	○	○	○
Time to investigate and explore technology options.	○	○	○	○	○
Access to appropriate technology supports when needed.	○	○	○	○	○
Technology support for infrastructure and networking issues that foster technology use in the classroom.	○	○	○	○	○
Funding for technology use.	○	○	○	○	○

12. Are there other factors not listed in the above section which impact your ability to utilize technology with diverse students?

○ A. Yes

B. No

If yes, please describe

Make sure to click the Submit button below to record your responses

Submit

APPENDIX C

Administrator Survey

All administrators were surveyed electronically via email. They were sent an email, which was the letter of introduction. The letter contained a link which took them to the website where the survey was located. Participants indicated their informed consent by clicking “I Agree” or “I Decline” after being presented with the research study information.

Dear ______________,

I am requesting your participation in a survey of school personnel from across Indiana that will contribute to the completion of my doctoral dissertation. You were selected because a team of teachers and administrators from your school have participated in professional development in Universal Design for Learning (UDL) provided through the Indiana Department of Education.

Even if you did not participate in the UDL training, your input is valuable. This online survey will examine how instruction is differentiated in your class or school to meet the needs of diverse learners and how technology is used to facilitate that differentiation.

The link below will direct you to an Internet-based survey. The survey should take less than 10 minutes to complete. Participation is voluntary and you can decline at any time. However, your participation will provide valuable information about how instruction can be differentiated to meet the needs of diverse learners.

The survey will be available until September 16th and your participation would be greatly appreciated.

http://inquisitor.bsu.edu/inqsit/inqsit.cgi/wyndham?Admin+Survey!1103005

Sincerely,

Scott Wyndham

Assistant Director of Special Services

MSD of Wayne Township

(317) 988-7931

Study Title: School Faculty Perceptions of the Use of Technology to Accommodate Diverse Learners: A Universal Design for Learning Framework

Study Purpose and Rational: The purpose of this research project is to examine how training and professional development in Universal Design for Learning affects school faculty's perceptions of differentiating instruction and using technology to address the needs of diverse learners. Findings from this research will be added to a growing research base in how Universal Design for Learning principles can be of benefit to teachers and students.

Participation Procedures and Duration: For this project you will be asked to complete a survey. It will take approximately 10-15 minutes to complete.

Data Confidentiality: All data will be maintained as confidential and no identifying information such as names will appear in any written work concerning this study including any publication or presentation of the data.

Storage of Data: Survey data will be entered into a software program and stored on the researcher's password protected computer in a locked office for two years and then deleted.

Risks or Discomforts: There should be no risk or discomfort from participating in this project.

Benefits: The benefits of participating in this project will be a broader understanding of how Universal Design for Learning principles can impact education.

Voluntary Participation: Your participation in this survey is completely voluntary and you are free to withdraw your permission at any time and for any reason.

IRB Contact Information: For one's rights as a research subject, you may contact Research Compliance, Office of Academic Research and Sponsored Programs, Ball State University, Muncie, IN 47306, (765) 285-5070, irb@bsu.edu.

Researcher Contact Information:
Principal Investigator: Scott Wyndham, (317) 839-0243, scott.wyndham@wayne.k12.in.us
Faculty Sponsor: Dr. Michael Harvey, (765) 285-5715, mwharvey@bsu.edu

To proceed with this survey, please click "I Agree" below.
To decline participation, please click "I Decline" below.

BALL STATE UNIVERSITY
EDUCATION REDEFINED

Important Information:

- Your responses will not be recorded until you click the button at the end of this page.

About This Survey

This survey is intended to obtain information about accommodating diverse learners and how technology is used to engage students, present material, and assess students. This research is specifically interested in whether training in Universal Design for Learning (UDL) changes teachers' perceptions about the curriculum, instruction, and assessments that they use in their classrooms.

This study will identify the perceptions of school faculty in the following areas: the inclusion of students with disabilities, how technology is used in classrooms, differentiating instruction, and student engagement. Additionally, factors that positively impact the use of technology to accommodate the needs of all learners will also be analyzed.

Your participation in this study is appreciated. Your responses will help identify ways that UDL can be supported throughout schools to accommodate the needs of all learners.

Please answer the following questions about the teachers in your school. *If you have participated in, or are participating in, the PATINS Universal Design for Learning grant program, please answer these questions based solely on the teachers in your school who have also participated in the UDL grant initiative.*

Section I. – Demographics

This section of the survey will ask some background information about your experiences and position within your school.

1. What is the best description of your role within the school/district in which you work?

   A. Building Principal/Asst. Principal

   B. Special Education Administrator

   C. Technology Administrator

- D. Superintendent/Asst. Superintendent
- E. Other

If other, please describe

---

2. What is the best description of the school/district in which you work?

- A. Elementary
- B. Middle School/Jr High
- C. High School
- D. District Level
- E. Other

If other, please describe

---

3. What is your age?

- A. Under 24
- B. 25-34
- C. 35-44
- D. 45-54
- E. 55 and over

---

4. How many years have you been working in education?

- A. 0-5 years
- B. 6-10 years
- C. 11-20 years
- D. 20+ years

---

5. Have you participated in the Universal Design for Learning (UDL) Grant Initiative through the PATINS Project?

- A. Yes. I am currently participating in the PATINS UDL Project.
- B. Yes. I have completed participation in the PATINS UDL Project.
- C. No.

6. Have you participated in any Universal Design for Learning (UDL) trainings within your school or district?
   - A. Yes
   - B. No

7. Have you participated in any other technology professional development opportunities in the last 5 years?
   - A. Yes (please describe)
   - B. No

   If yes, please describe

<u>**Section II. – Classroom/School Perceptions**</u>

This section of the survey will address your perceptions of addressing students with diverse needs in general education classrooms. ***Please rate on a 100 point scale with Strongly Disagree being 0-25, Disagree being 26-50, Agree being 51-75, and Strongly Agree being 76-100.***

8.

Please rate using the Likert-type Scale	**Strongly Disagree (0-25)**	**Disagree (26-50)**	**Agree (51-75)**	**Strongly Agree (76-100)**	**Do not know**
Students with disabilities in my school are adequately included into general education classrooms.					
Students with disabilities in my school who are included in general education classrooms are making adequate progress toward the grade-level standards in the curriculum being taught.					
The primary responsibility for accommodating classroom activities for students with disabilities included in general education classrooms lies with special education teachers.					
Accommodations designed for students with disabilities usually create increased opportunities for all learners.					

The more choice that students have in their instruction and assessment, the more engaged they will be in the material being presented.	◯	◯	◯	◯	◯

Section III. - Classroom Strategies

This section of the survey addresses how instruction is differentiated within your school. Please indicate how often the following statements apply within your school.

9.

Please rate using the Likert-type Scale	Never (not at all)	Sometimes (1-2 times/month)	Often (1-2 times/week)	Very Often (Daily)	Do not know
Teachers in my school present material to students through multiple means to allow for more flexibility in instruction.	◯	◯	◯	◯	◯
Students in my school are presented with choices in how they receive core instruction.	◯	◯	◯	◯	◯
Teachers in my school utilize technology to provide students with more choice and flexibility in completing assignments.	◯	◯	◯	◯	◯
Teachers in my school utilize technology to present material in ways that support all students learning.	◯	◯	◯	◯	◯
Teachers in my school utilize technology to present material in a way that actively engages students in their learning.	◯	◯	◯	◯	◯
Students in my school are given choices in how they are assessed and demonstrate their learning.	◯	◯	◯	◯	◯
Students in my school are presented with opportunities to express what they have learned	◯	◯	◯	◯	◯

using technology.					
Teachers in my school utilize technology to provide ongoing assessments of student progress.	○	○	○	○	○

---

10. **Please indicate how often students in your school use technology in the following ways.**

Please rate using the Likert-type Scale	**Never (not at all)**	**Sometimes (1-2 times/month)**	**Often (1-2 times/week)**	**Very Often (Daily)**	**Do not know**
Word Processing	○	○	○	○	○
Research	○	○	○	○	○
Drill and practice of specific skills	○	○	○	○	○
Software programs to learn new skills	○	○	○	○	○
Software programs to reinforce concepts and skills previously learned	○	○	○	○	○
Assessments/tests online	○	○	○	○	○
Homework online	○	○	○	○	○
Multi-media presentations (e.g., Power Point)	○	○	○	○	○
Communication with other students/teachers (e.g., e-mail, blogs, podcasts)	○	○	○	○	○
Text-to-speech programs	○	○	○	○	○
Organization (e.g., graphs, tables, spreadsheets, graphic based organizers)	○	○	○	○	○
Interactive presentation technology (e.g., Smart Boards)	○	○	○	○	○
Mobile technology (e.g., Palm Pilots, ipods)	○	○	○	○	○
Interactive assessments (e.g., Classroom	○	○	○	○	○

Response Systems)					
Web based tools (e.g., wikis, blogs, social networks)	◯	◯	◯	◯	◯

Section IV. - Factors Impacting Technology Integration

This section of the survey addresses facts that impact how technology is used by teachers. Please indicate how important the following factors are in supporting technology integration within your class. ***Please rate on a 100 point scale with Not Important being 0-25, Somewhat Important being 26-50, Important being 51-75, and Very Important being 76-100.***

11.

Please rate using the Likert-type Scale	Not Important (0-25)	Somewhat Important (26-50)	Important (51-75)	Very Important (76-100)	Do not know
A school-wide technology plan with clear expectations for teachers and students.	◯	◯	◯	◯	◯
A principal that models the use of technology in daily school activities.	◯	◯	◯	◯	◯
Encouragement from the principal to utilize technology within the classroom.	◯	◯	◯	◯	◯
Professional development focusing on utilizing technology to accommodate diverse students.	◯	◯	◯	◯	◯
Collaboration with other teachers, technology personnel, and administrators.	◯	◯	◯	◯	◯
Recognition from the principal when utilizing technology within the classroom.	◯	◯	◯	◯	◯
Involvement in administrative decisions about technology, uses, functions, and locations.	◯	◯	◯	◯	◯
Time to investigate	◯	◯	◯	◯	◯

and explore technology options.					
Access to appropriate technology supports when needed.	◯	◯	◯	◯	◯
Technology support for infrastructure and networking issues that foster technology use in the classroom.	◯	◯	◯	◯	◯
Funding for technology use.	◯	◯	◯	◯	◯

12. Are there other factors not listed in the above section which impact your teachers' ability to utilize technology with diverse students?

◯ A. Yes

◯ B. No

If yes, please describe

Make sure to click the Submit button below to record your responses

Submit

APPENDIX D

IRB Approval Documents

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Scott Wyndham** successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 05/03/2009

Certification Number: 225779

BALL STATE UNIVERSITY

Institutional Review Board

DATE: July 22, 2009

TO: Scott Wyndham

FROM: Ball State University IRB

RE: IRB protocol # 118960-2

TITLE: School Faculty Perceptions of the Use of Technology to Accommodate Diverse Learners: A Universal Design for Learning Framework

SUBMISSION TYPE: Modification/Amendment

ACTION: DETERMINATION OF EXEMPT STATUS

DECISION DATE: July 22, 2009

The Institutional Review Board reviewed your protocol on July 22, 2009 and has determined the procedures you have proposed are appropriate for exemption under the federal regulations. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol. As an exempt study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record.

While your project does not require continuing review, it is the responsibility of the P.I. (and, if applicable, faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified or if problems related to human research participants arise in connection with this project. **Any procedural modifications must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project.** Please contact Amy Boos at (765) 285-5034 or akboos@bsu.edu if you are unsure whether your proposed modification requires review or have any questions. Proposed modifications should be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb) for review. Please reference the above IRB protocol number in any communication to the IRB regarding this project.

Reminder: Even though your study is exempt from the relevant federal regulations of the Common Rule (45 CFR 46, subpart A), you and your research team are not exempt from ethical research practices and should therefore employ all protections for your participants and their data which are appropriate to your project.

TO: Scott Wyndham
CC: Michael Harvey
FROM: Amy Boos
RE: IRBNet Board Action
Date: 7/22/2009 1:49 pm

Please note that Ball State University IRB has taken the following action on IRBNet:

Submission: [118960-2] School Faculty Perceptions of the Use of Technology to Accommodate Diverse Learners: A Universal Design for Learning Framework
Action: EXEMPT
Effective Date: July 22, 2009

Should you have any questions you may contact Amy Boos at akboos@bsu.edu.

Thank You,
The IRBNet Support Team

www.irbnet.org

TO: Scott Wyndham
CC: Michael Harvey
FROM: Amy Boos
RE: IRBNet Board Action
Date: 7/22/2009 1:49 pm

Please note that Ball State University IRB has published the following Board Document on IRBNet:

Submission: [118960-2] School Faculty Perceptions of the Use of Technology to Accommodate Diverse Learners: A Universal Design for Learning Framework
Document: Exempt Letter
Publish Date: July 22, 2009

Should you have any questions you may contact Amy Boos at akboos@bsu.edu.

Thank You,
The IRBNet Support Team

www.irbnet.org